ANNALS
OF
OTOLOGY, RHINOLOGY
AND
LARYNGOLOGY

INCORPORATING THE INDEX OF OTOLARYNGOLOGY.

VOL. XXX. MARCH, 1921. No. 1.

I.

THE ETIOLOGY OF ACUTE INFLAMMATIONS OF THE NOSE, PHARYNX AND TONSILS.*

BY STUART MUDD, M. D., SAMUEL B. GRANT, M. D., AND ALFRED GOLDMAN, M. D.,

FROM THE DEPARTMENT OF PATHOLOGY, WASHINGTON UNIVERSITY SCHOOL OF MEDICINE, ST. LOUIS, MO., AND THE LABORATORY OF BIOPHYSICS OF THE CANCER COMMISSION OF HARVARD UNIVERSITY, BOSTON.

*The original experiments described in this paper were chiefly performed at Washington University, St. Louis, by the above authors. The paper itself is a revision of a dissertation submitted by Stuart Mudd and awarded for 1920 the Boylston Medical Prize of Harvard University, which is open to public competition. By an order adopted in 1826, the Secretary of the Boylston Medical Committee was directed to publish annually the following votes:

1. That the Board does not consider itself as approving the doctrines in any of the dissertations to which premiums may be adjudged.
2. That, in case of publication of a successful dissertation, the author be considered as bound to print the above vote in connection therewith.

SUMMARY.

Page

I. Introductory 3

II. Bacteriology of the Common Cold..... 4

Micrococcus of Hüter.
Diplococcus coryzæ.
B. septus.
Micrococcus catarrhalis.
B. diphtheriæ.
Pneumococcus.
Bacillus of Friedländer.
B. rhinitis, Tunnicliff.
Streptococci.
B. influenzæ.
Filterable virus of influenza (?).
Filterable virus of Kruse and Foster.
Coolidge's Clinical Differentiation.

Conclusions 12

III. Excessive Chilling as an Excitant of Infection..... 12

Reflex effects.
Positions of the Authorities.
Statistical Evidence.
Lowering of General Resistance by Lowering Blood Temperature.
Congestion Theory.

Experimental Studies of Vasomotor Reactions of Human Subjects to Chilling of the Body Surface..... 17

Methods.
Apparatus Used.
Application of the Thermopile Terminals.
Arrangement of the Subject.
Factors Determining Superficial Temperature Changes.
Control Experiments:
(a) Respiration and Chilling.
(b) Blood Pressure and Chilling.
(c) Blood Temperature and Chilling.

Vasomotor Reactions to Chilling:

Composite Graph of Temperatures of Skin and Mucous Membrane of Oropharynx and Soft Palate.
Curve of Skin and Soft Palate.

Curve of Skin and Oropharynx.
Curve of Skin and Nasopharynx.
Composite Graph of Skin and Palatine-Pharyngeal Mucous Membrane and of Skin and Tonsillar Mucous Membrane.
Curves of Skin and Faucial Tonsil.
Composite Graph of Skin and Mucous Membrane of Nasal Cavity.
Curve of Skin and Left Inferior Turbinate.
Checking of Quantitative Results by Qualitative Observerations of Redness.
Vasomotor Reactions of Abnormal Tissues:
(a) Reactions in Chronic Inflammatory Throats.
(b) Reaction in an Acute Inflammatory Palate.
(c) Scar Tissue Reactions.
After Effects of Chilling, Experiments of Series of 1918 48
Concurrent Bacteriologic Studies, Summer of 1919..... 49
Material and Method.
Results.
Conclusions.
Concurrent Bacteriologic Studies, Summer of 1920..... 60
Results.
Discussion.
Interpretations of Reactions to Chilling..... 63
Prophylaxis 67
IV. Anaphylactic "Colds" 67
V. Acute Inflammations Due to Systemic, Toxic and Neurotic Factors, to Mechanical and Chemical Irritation, to Extreme Low Temperature, and to Nasal Obstruction 68
VI. Conclusions 70
VII. Bibliography 71

I.—INTRODUCTORY.

That a state of confusion exists as to the etiology of the acute inflammations of the upper respiratory tract is evident upon casual excursion into the literature. A more patient search, however, reveals certain material, notably in the form of recent laboratory work, from which definite conclusions can be drawn, and in whose light the discussions of the "common

cold" in the current texts is clearly seen to be obsolete. The present dissertation is concerned with the etiology of the acute inflammations of the nose, pharynx, and fauces, particularly with reference to recent laboratory inquiries. The question of the excitation of sporadic infections by exposure of the body surface to cold is dwelt upon in considerable detail—much more at length than its relative importance deserves, indeed—simply because the newer data here presented are the contribution of the present authors.

Since the early days of bacteriology, attempt has been made by the several proponents and opponents of the infectious theory to refer the "common cold" on the one hand to the action of a specific microorganism, and on the other to various environmental and constitutional causes, such as exposure to changes of temperature, the "lithemic diathesis," and what not. Although perhaps laudable as philosophic ideals, such efforts to explain the many phenomena involved by a single cause are less deserving scientifically, and have met with just failure. The "common cold" is, as a matter of fact, in most instances the result of a local infection, but there are many types of "cold" and many infectious agents responsible for them; and the effect of various constitutional and environmental factors in determining infection is often of great importance. Furthermore there are many acute inflammations of the upper respiratory tract not primarily due to the local action of microorganisms, but rather the local expression of chemical or mechanical irritation, of nervous reflexes, of drug intoxications, of constitutional disease, or of anaphylaxis.

II.—BACTERIOLOGY OF THE COMMON COLD.

The studies of a number of investigators have shown that, although the entrance of the nose is swarming with bacteria, the flora of the nasal cavities proper in health are kept exceedingly sparse by the action of the ciliated epithelium, the trickling of the lacrimal and mucous secretions, the inhibitory action of the mucus, and by phagocytosis. (Thomson, 1913, p. 7.) The folds of the pharyngeal mucosa and especially the crypts of the tonsils are, on the other hand, known to maintain even in health an abundant flora, including often potentially pathogenic organisms (e. g., see Davis, 1920). Bacterio-

logic studies of the nose and throat in the course of acute "colds" have usually shown the presence of microorganisms in unwontedly large numbers, often with one form so predominating as to suggest for it an etiologic relationship with the cold. In a number of instances immunologic and inoculation data have supported the bacteriologic evidence and would seem to warrant assumption of a causal relationship between the bacteria and the colds in question.

In 1873, Hüter described a micrococcus as a cause of coryza (cited by Benham, 1906).

Hajek (1888) described a large diplococcus, the Diplococcus coryzæ, in the early stages of acute colds. He advances no other evidence in support of his bacteriologic findings, however. Certainly in the light of recent experience with influenza, the mere presence of bacteria in large numbers during an inflammation cannot be regarded as valid ground for considering them its cause. (For a discussion of bacteriologic methods in estimating the relationship of microorganisms to respiratory disease, see Allen, 1913.)

Paulsen (1890), examining twenty-four cases of cold, of diverse clinical types, some with history of exposure to other persons with colds, and others following exposure to chilling, found various cocci and bacilli as the predominating organisms.

Cautley (1894-95) found an aerobic diphtheroid bacillus, oval, with a tendency to polar segregation of the protoplasm, in seven of eight cases of acute cold of various types. The infection started in the trachea, pharynx or nose. Cautley, believing the organism responsible for coryza, called it B. coryzæ segmentosus. Gordon (quoted by Benham, 1906) found Cautley's bacillus in all of seven cases of cold. Gordon injected two guinea pigs with the organism and noted they were sick a few days, but recovered. R. Prosser White (quoted by Benham, 1906) found Cautley's bacillus in seventeen of twenty-one cases. Inoculation experiments upon the noses and genital tracts of guinea pigs, rabbits and monkeys were negative.

Benham (1906) found a diphtheroid organism he regards as identical with Cautley's bacillus in twenty of twenty-one cases of cold. Micrococcus catarrhalis was also present in many cases. He concludes: "in view of the fact that nasal

discharge was not a prominent feature of my series of cases, it seems likely that the diphtheroid organisms are rather a cause of a painful sore throat with headache, malaise and muscular pains, irritable cough and scanty, viscid expectoration. Whether they cause coryza—a cold in the head—is at least open to question, especially in view of the presence of M. catarrhalis in nearly half my cases." Benham therefore gives Cautley's B. coryzæ segmentosus the less committal name of Bacillus septus.

Micrococcus catarrhalis was found by R. Pfeiffer (quoted by Neisser in Kolle and Wassermann's "Pathogenen Mikroorganismen," 1913) in enormous numbers in the sputum of an epidemic of mildly febrile cases of bronchitis. Gohn and H. Pfeiffer (1902) found this diplococcus in eighty-one of one hundred and forty cases of respiratory tract infection. They regarded it as a saprophyte which can under appropriate circumstances give rise to acute or subacute infection. Bezançon and de Jong (1905) found this organism very frequently in an influenza-like epidemic in Paris. Along with M. catarrhalis they found micrococcus paratetragenus, pneumococcus, Friedländer's bacillus, staphylococcus, streptococcus and diphtheroids. Dunn and Gordon (1905) believed the micrococcus catarrhalis to be the chief organism in a severe epidemic in Hertfordshire with clinical manifestations in different cases simulating cerebrospinal fever, influenza and scarlatina. Allen (1906) made claim to have isolated M. catarrhalis with ease from each case examined in a severe local epidemic of colds in England.

Neumann (1902), as a result of a considerably more extensive and thorough bacteriologic study than the foregoing, concluded that virulent diphtheria bacilli and the pneumococcus at least, perhaps other organisms, could produce the ordinary cold.

He summarizes as follows the results of his study of the flora of the noses of 111 normal persons and of 95 suffering from nasal affections of various sorts:

"The total number of bacterial species found was 19. Nevertheless in most cases there are relatively few different species found present together. Most frequently are found diphtheroid bacilli and white micrococci. Less frequently orange, gray

and yellow micrococci, pneumococci, streptococci, Friedländer's bacilli, diphtheria bacilli, isolated colon bacilli, yeast, molds, mixed bacilli, sarcinæ and still a few other organisms.

"Micrococcus pyogenes albus is present in 86 to 90 per cent, diphtheroids in 98 per cent of the cases, so that one can justly assert that the latter occur in every sound and pathologic nose. The more delicate form (B. xerosis) is much more frequent than the more luxuriantly growing form (Hoffman's bacillus).

"In colds the pathogenic organisms, pneumococcus, Friedländer's bacillus, streptococcus pyogenes and diphtheria bacillus are more prominent than in normal noses.

"The diphtheroid bacillus is not virulent. Seventy-eight strains cultivated from different noses in no case killed guinea pigs. In a few cases only weak infiltrations appeared at the site of injection. The organism cannot be brought into relationship with the origination of the cold and is only to be considered as a harmless saprophyte.

"Certainly it is demonstrated that virulent diphtheroid bacilli and Fränkel's pneumococcus can cause the clinical picture of the common cold. Whether and in what way other pathogenic germs are concerned in it, is still to be answered.

"A specific cause of the cold has not been found in the investigations."

Claims for the bacillus of Friedländer as a cause of "cold" are advanced, with immunilogic support, by Allen (1906). Allen asserts that in each of two epidemics of a severely infective character, in every case examined within the first 24 hours, and in some later, the bacillus was found. "It was of a very virulent stamp, being pathogenic not only for mice and guinea pigs but even for rabbits; it also clotted milk and fermented broth with ease."

Claims for an etiologic relationship are based upon the following statements, which, if true, would seem to establish the point:

"The appearance of the bacilli in the nasal passages of the people affected synchronized with the onset of the attack.

"The organism and colds disappeared together.

"The opsonic index of the patient's blood, which was particularly studied, to the bacillus of Friedländer was affected by a cold precisely in the way that would be expected in the case of an infection by that organism—that is, it rose steadily to a maximum, remained there for some time, then steadily fell to about unity during a period of perfect freedom from cold. Second and third attacks had precisely similar results.

"The appearance in the house of a person whose nasal passages were known to be infected by the bacillus of Friedländer sufficed to start an epidemic of colds on several occasions; and from the noses of such as were examined the bacillus of Friedländer was also isolated."

Work somewhat more convincing than any of the foregoing has been reported by Tunnicliff (1913, 1915) and Howell (1915). The organism is an anaerobic curved bacillus. B. rhinitis, Tunnicliff.

Miss Tunnicliff, working in Chicago, found her bacillus present in 6 per cent of some 86 normal noses examined, in 98 per cent of 82 cases of acute coryza, and in 90 per cent of twenty-odd cases of chronic rhinitis with mucoid discharge.

A slight rhinitis was produced three times in human subjects by swabbing a nose free from B. rhinitis with a pure culture. The infection began from six to eight hours after the inoculation and lasted about 48 hours. The organisms were present in fairly large numbers in the nose and pharynx (in the cases with pharyngitis), 18 hours after the inoculation, and persisted for three days in two of the cases. Cultures were made twice, and the organisms isolated in pure culture both times. The opsonic index was taken during two of the infections. Both times it fell below normal, rising high above normal as the infection disappeared.

Vaccination of two patients with B. rhinitis produced a primary depression of the opsonic index followed by a rise above normal.

Miss Howell found that, using B. rhinitis as antigen, fixation of complement is obtained with the sera of persons with acute rhinitis and of persons injected with the bacillus after it is killed by heat. The fixation is most marked a few days after the onset of the infection and lasts only a short time. Sera of normal persons and of patients with various infectious dis-

eases do not give complement fixation with the bacillus rhinitis.

It is difficult to escape the conclusion that B. rhinitis was causally related to these cases of acute coryza about Chicago.

That streptococci may be responsible for infections of the nose, and more especially the pharynx and tonsils, has been shown by many authors (vide Lingelsheim, 1912, and Barnes, 1914, p. 67).

Mathers (1917) made a careful bacteriologic study, using aerobic, anaerobic and filtration methods, of an epidemic of acute respiratory infection in Chicago, which resembled the influenza of 1889-92. He concluded that a virulent hemolytic streptococcus was the probable cause.

Floyd (1920), as a result of bacteriologic study and vaccine therapy of the winter colds occurring in and around Boston, concluded that in acute rhinitis the organism commonly found belongs to the staphylococcus group, and that somewhat less frequently the hemolytic streptococcus has appeared. In acute pharyngitis "almost invariably the initial infection is produced by the member of the streptococcus group."

Pneumococcus has also frequently been recognized as concerned with infections of the upper respiratory tract (v. Abel, 1892; Neufeld u. Händel, 1912; Floyd, 1920).

Discussion of B. influenzæ has purposely been left out of this paper. Under this caption, however, may be quoted the conclusions of R. W. Allen (1913), based upon some ten years of bacteriologic study of the respiratory diseases, in England.

"To summarize," he writes, "it would appear that any of the seven organisms, B. influenzæ, pneumococcus, streptococcus, M. catarrhalis, M. paratetragenus, B. septus, and bacillus of Friedländer, alone or in varying combinations, may be responsible for a catarrhal condition of the upper respiratory passages. In perhaps 40 per cent of cases one organism so predominates as to justify the conclusion that it is the cause of the attack; more often two or more organisms are associated together, the B. influenzæ with the pneumococcus or M. paratetragenus, the B. septus with the M. catarrhalis or M. paratetragenus, so that it becomes very difficult to decide which organisms stand in a directly causal relationship to the attack. My own belief is that mixed infections from the beginning are fairly common.

"In uncomplicated purulent nasal catarrh the streptococcus is the most frequent cause, next to it the staphylocccus aureus. When sinus complications coexist the B. influenzæ and pneumococcus are by far the most frequent bacteria concerned."

Blake and Cecil (1920) have also reported successful infection of monkeys with B. influenzæ introduced both into the nose and intratracheally.

Cecil and Steffen (1921) have more recently produced by human inoculation with a freshly isolated virulent strain of B. influenzæ an acute self limited upper respiratory infection with local and constitutional symptoms like those of a mild endemic influenza or severe coryza.

Although any attempt at adequate discussion of the etiology of epidemic influenza is outside the scope of the present paper, its virus must be included among those capable of giving rise to acute inflammation of the upper respiratory tract. We would express our own opinion, too, that the attributes of a specific, labile and elusive virus, to which so many converging lines of evidence have pointed, are extraordinarily well filled by the filterable virus which has been the object of the past two years of careful study by Olitsky and Gates at the Rockefeller Institute (Olitsky and Gates, 1920, 1921), and which has been isolated independently by Loewe and Zeman (1921). For a bibliography and brief review of "The Epidemiology and Etiology of Influenza" reference is made to A. J. McLaughlin (1920).

A filterable virus seems without question to be the causative agent in the coryza of one fairly well defined type. Kruse (1914) diluted the secretion from the nose of an assistant with coryza, passed it through a small Berkefeld filter, and dropped a few drops of the filtrate on the nasal mucosa of each of twelve men. Four of them developed colds in from one to four days. In a second experiment 42 per cent of thirty-six subjects so inoculated developed coryza within from one to four days. Kruse could find no living organisms in his filtrates by bacteriologic methods.

Foster (1916) in repeating and extending this work, passed through a small Berkefeld N filter, with aseptic precautions, the nasal secretion of persons suffering from acute colds. This filtrate he proved to be free from ordinary bacteria, both by

aerobic and anaerobic methods. From three to six drops of the filtrate was placed in each nostril of each of ten soldiers. Nine of the ten men developed the usual symptoms of acute coryza in from eight to thirty hours. Inoculated into tubes of tissue broth or tissue ascitic fluid under petrolatum, after the method of Noguchi and Flexner with rabies and poliomyelitis virus, this filtrate produced a growth which could be subcultured apparently indefinitely. Specimens of these subcultures were again diluted, passed through a Berkefeld filter, and a few drops allowed to run into the noses of eleven healthy soldiers, every one of whom developed, after an incubation period of eight to forty-eight hours, acute colds. Cultures from these individuals' nasal secretions gave the same appearance as the original cultures. They contained an abundant growth of a pleomorphic virus varying from minute globoid bodies to coccoid forms larger than staphylococci, the latter apparently in some instances with small globoid buds. (Foster, 1917.)

The clinical picture described by Foster, both for his original patients and for the subjects of the inoculation experiments, is worth giving by a typical case. The patient "complained of lassitude, chilly sensations, sneezing, unilateral nasal stuffiness, dull frontal headache with a feeling of oppression over the eyes, impairment of smell and moderate aching pain in the extremities. There was the usual lacrimation, a copious, thin, mucoid nasal discharge, which excoriated the upper lip and the alæ of the nose, and a very red, moist, swollen and boggy mucosa. The temperature was normal."

The contention of Prof. M. J. Rosenau, in whose laboratory Foster's work was done, that this type of acute coryza deserves to be considered a clinical entity, would appear to be well founded. It is extremely interesting that a symptom complex has been separated on purely clinical grounds from the remaining congeries of nose and throat affections. Coolidge (1918, p. 92) writes: "But there is one form of 'symptom complex' so common and constant that it might well be classed as a distinct and definite disease, and it is to this disease that the word 'cold' is most frequently applied." His description of it closely corresponds to Foster's.

A survey of the literature then would seem to warrant the following conclusions:

1. A common and fairly well defined clinical entity, an acute coryza, exists, probably with the filterable virus of Kruse and Foster as its causative agent. This affection is readily communicable and probably does not depend to any great extent upon the action of exciting factors in depressing the resistance of the subject. 2. A heterogeneous group of pure and mixed infections of the nose, pharynx and tonsils exists with various clinical pictures—some closely approaching that of Foster, others mere circumscribed inflammations—and with any one of a considerable number of bacteria capable, under appropriate circumstances, of acting as causative agents.

The microorganisms whose etiologic rôles seem to the writer to be best established are pneumococcus, streptococcus, B. diphtheriæ, B. rhinitis, Friedländer's bacillus, and B. influenzæ. Strong bacteriologic evidence, unsupported, however, so far as the writer knows, by immunologic or experimental data, has been advanced for M. catarrhalis, B. septus, M. paratetragenus, and S. aureus. The possibility that still other organisms may be primarily or secondarily involved is of course not excluded. Wide variations in virulence exist, both between different organisms and probably from time to time in the same bacterial strain (see Allen, 1913); some organisms are doubtless capable of causing infections in epidemic proportions, nearly or quite independent of accessory exciting factors; others may exist as harmless saprophytes upon the mucous membranes, causing infection only when the resistance of their host, local or general, is lowered by some exciting factor.

III.—EXCESSIVE CHILLING AS AN EXCITANT OF INFECTION.

It is not the purpose of the present dissertation to attempt a sifting of the large amount of evidence, collected chiefly by ordinary and by clinical observation, which bears upon the question of the predisposing and exciting factors of upper respiratory infections. Suffice it to say that anything which lowers resistance, general or local, may disturb the equilibrium between host and parasite in the direction of exciting infection. The present section of this dissertation will concern

itself with one particular factor only—namely, exposure to cold.

In the consideration of cold as an excitant of mucous membrane infection the issue has been somewhat confused by certain other effects of chilling. One of the immediate results of exposure, for instance, may be a transient rhinorrhea having no necessary relation to "catching cold." Again, a very slight draft of cool air may, in the stage of onset of a cold, be accompanied by a feeling of chilliness or even a rigor—this is obviously an effect and not, as it is sometimes wrongly considered, an antecedent of the infection.

But, in addition, it would seem to be a fact attested by long and general experience that excessive exposure to cold may be an actual excitant of rhinitis, pharyngitis or tonsillitis. For history of observation and thought on the subject, see the extensive monograph by Sticker (1916) on "Erkältungskrankheiten und Kälteschäden."

Certainly the weight of authority is in support of this thesis. Of the laryngologic texts, the following recognize chilling as an efficient factor in exciting infection: Grayson (1902), Ballenger (1908), Coakley (1914), Kyle (1914), Wright and Smith (1914), Phillips (1919), and Tilley (1919). However, Thomson (1913) and Coolidge (1918) are skeptical. In support of the affirmative are Marchand, in Krehl u. Marchand's Handbuch d. Allgemeinen Pathologie (1908), Lingelsheim in Kolle u. Wassermann's Handbuch d. pathogenen Mikroörganismen (1912), Packard in Osler and McRae's Modern Medicine (1914), Barnes, "The Tonsils" (1914), Barker, Monographic Medicine (1916), Sticker (1916), in the Enzyklopödie der Klinischen Medizin, MacCallum's Pathology (1920), and Rosenau (1920). The experiments of Miller and Noble (1916), who have shown that the liability of rabbits to respiratory infection by B. bovisepticus is heightened by exposure to cold after overheating or by overheating after chilling are extremely suggestive in this connection. We, too, have obtained some experimental evidence (Mudd and Grant, 1919; Grant, Mudd and Goldman, 1920), as will be shown later, which would seem to afford support to the thesis that mucous membrane infection may be excited by chilling the body surface.

What would seem to be conclusive evidence in establishing excessive exposure to cold as an efficient excitant of acute upper respiratory affections has recently come from Germany in the form of statistics for large bodies of troops during and before the war (Schade, 1919). The data in brief are as follows:

(a) Comparison of the incidence of disease during the mild winter of 1915-16 and during the very severe winter of 1916-17. The increase of disease incidence rose to almost twice the total in 1916-17; the largest single factor in this increase was the heightened incidence of respiratory affections, which in February, 1917, rose to 7.6 times the usual summer rate.

(b) Comparison of sickness among 8,000 infantry troops of whom one part (2,700 men) were subjected for three days and nights to conditions of severe cold and wet, while the rest stayed behind during the same weather in village quarters. In spite of hardening by the three previous years of trench warfare, the incidence of acute respiratory diseases, "rheumatic diseases" and acute urinary affections, chiefly acute bladder irritation with diurnal and noctural enuresis, was four times as great among the exposed as among the sheltered troops.

(c) Comparison of sickness among 8,000 infantrymen of whom one part (4,500 men) were exposed three days and nights to extreme cold (—9° to —12° C. midday temperature), accompanied by a sharp, gusty wind, while the remaining 3,500 men were in sheltered quarters. The exposed troops comprised 160 cases of "exposure disease"—i. e., 128 acute respiratory cases, 28 of rheumatism, 4 of severe bladder irritation, and 4 of freezing. Reckoned on a basis of equal numbers of men, the sheltered troops had only 40 cases of "exposure disease" and 1 of freezing.

(d) Comparison of daily incidence during three months of diseases of the respiratory tract with that of "rheumatic" affections among 8,000 troops. The curves are clearly parallel. On the same days in which the number of cases of respiratory tract catarrh increased the cases of rheumatic pain became more numerous also.

(e) Comparison of incidence of "diseases of exposure" (see above) with that of cases of freezing. Daily curves for 8,000 troops show parallelism.

The sanitary reports of the Prussian war ministry, comprising all detected diseases among all the men of Prussia, Saxony and Würtemberg in compulsory military service (more than a half million annually) have been analyzed and plotted for monthly intervals over twelve years. Of upper respiratory diseases, excluding tonsillitis, 428,714 cases are included; of "acute muscular rheumatism," 72,179 cases, and of "frost bite," 12,898 cases. Always the upper respiratory diseases show in January and February their steep winter rise; year by year the incidence of "muscular rheumatism" and of frost-bite follow in astonishing parallelism.

The curves of incidence by month for the whole twelve years combined are also given. The curve for frost bite rises from the base line in October steadily to a crest in February and returns to the base line in May. It is nearly symmetrical and of the form of the familiar frequency polygon. The curve for tonsillitis (271,852 cases) rises closely parallel to the frost bite curve from December to its peak, almost identically placed in February, and descends again almost parallel until April. The tonsillitis curve is distinguished, however, by a small secondary peak in November and by its slope becoming less steep during the spring and summer so that the base line is not approached before the October rise begins. The curve for upper respiratory diseases, exclusive of tonsillitis, runs nearly parallel to that of tonsillitis, including the secondary mode in November, but reaches its summit in January.

Such close parallelism, as Schade also gives curves to show, is not to be found between the incidence of diseases of exposure and air temperature; it is apparently with the cooling power of the air, as determined by temperature, humidity and air movement, and expressed in the frequency of frost bites, that the parallelism exists.

It is difficult to see how one could study the curves and yet escape the conclusion of the author that "chilling by the weather and the occurrence of respiratory tract catarrh stand certainly in the closest correlation."

Incidentally, to digress for a moment, the efficacy of the common respiratory affections in lowering resistance and preparing the way for the specific infections of mumps, scarlet

fever and measles is shown in other curves in this most illuminating paper.

In all fairness it should be said, however, that Schade's military statistics cannot be used without some reservation in interpreting conditions of ordinary civilian life. It seems quite probable that actual lowering of body temperature may have played a much more important rôle in the incidence of respiratory disease in his statistics than most students of the subject believe it does in ordinary life.

It is probable, too, that in the general population, where the physical condition does not average so high as among the young men studied by Schade, and where exposure is not so severe, the element of contagion would play a much larger and weather a much smaller part in determining incidence of respiratory affections. However, even here, excluding the great epidemics, influenza and pneumonia begin with the frost, became severe when the temperature averages below freezing, reach a maximum when the temperature is lowest and then decline. (J. Am. M. Ass., editorial, 1920, lxxv, 1500.)

As to the mechanism of excitation of infection by chilling the skin, current opinion has gone curiously astray. Since the classic studies of Pasteur with anthrax and fowls with wet feet many authors have shown that animals whose blood temperature has been lowered may show decreased resistance to bacterial infection (Marchand, 1908). Trommsdorf (1906) further believed he showed in such animals a decreased motility and phagocytic activity of the leucocytes and a diminished capacity for regeneration of alexine and for elaboration of specific antibodies. (For literature on this subject, see Foord, 1918.) But, as Marchand himself says, and as our experiments would indicate (see below), no such considerable lowering of body temperature occurs in the majority of instances of exposure responsible for excitation of the common upper respiratory infections. Conditions in the existing animal experiments are not properly comparable to the conditions of "catching cold" in man; we must look elsewhere for an explanation.

The theory commonly advanced has been that cutaneous chilling, driving the blood inward, produces, by mechanical or reflex means, or both, congestion of the internal organs. In-

deed such congestion has been demonstrated in animal experiments by a number of authors: Lassar (1880) sectioned the lungs, livers and hearts of animals after immersion in ice water, and found their vessels greatly dilated. Schüller (1881) was shown congestion of the arteries and veins of the pia mater in animals chilled by application of cold compresses. Rossbach (1901), Kisskalt (1901) and others have made similar observations upon the epithelium of the exposed trachea. Winternitz (1881) has demonstrated an increase in the volume of the arm of a human subject immersed in a cold sitz-bath, a decrease in the arm's volume when the bath water was warm.

Many authors have assumed that such findings apply equally well to the human nose and throat. The common observation that chilling may in a few minutes be followed by a feeling of stuffiness in the nose, has seemed to lend plausibility to such an assumption. That it is nevertheless absolutely at variance with what actually occurs in the nasal cavity, nasopharynx, oropharynx, tonsils and palate is shown by the experiments to be described below.

EXPERIMENTAL STUDIES OF VASOMOTOR REACTIONS OF HUMAN SUBJECTS TO CHILLING OF THE BODY SURFACE.

Inquiry as to how the human upper respiratory mucous membranes are affected by chilling of the body surface has been undertaken by the present authors. (Mudd and Grant, 1919; Grant, Mudd and Goldman, 1920). The mucous membranes of the palate, faucial tonsils, oropharynx and nasopharynx and of the nasal cavity have been studied, primarily with regard to the vasomotor changes reflexly effected in them by chilling; and in the more recent work the changes in the bacterial flora occurring during the chilling experiments have also been considered.

Methods.—The experiments were performed upon human subjects, for the most part third and fourth year medical students and recent graduates.

Of the several criteria of vascular condition, heat seemed most readily susceptible of quantitative study. Estimation by inspection of the redness of the mucosæ was used as a check.

To follow superficial temperature changes in the sites under consideration by the direct application of thermometers was

quite impracticable. Thermogalvanometry was of necessity employed therefore.

Apparatus used: Two similar three-element thermopiles were made up of German silver and of copper wire. In making each thermopile, three lengths of the German silver wire about a yard long were soldered alternately to three pieces of copper wire of the same length. The wires were then folded together to make a single bundle of six strands with three German silver-copper junctions at one end for application to the surface of unknown temperature, and two junctions and a loose end of copper and another of German silver at the other end of the bundle, which was to be kept at a known temperature. To each of the loose ends was soldered a copper wire leading to a rocking key. The known-temperature end of the thermopile was packed in cotton with a sensitive thermometer in a test tube suspended in the room by a clamp about its neck, or packed in a thermos bottle containing ice water.

A second three-element thermopile was similarly arranged and connected to the rocking key. From this key copper wires were led to a D'Arsonval galvanometer. Thus, by pushing down, successively, the two ends of the rocking key, each of the thermopiles could be brought successively and separately into circuit with the galvanometer.

The unknown-temperature end of the mucous membrane thermopile, when applied, was continuously bathed in mucus, containing electrolytes. Its terminals had therefore to be insulated from each other; this was accomplished by dipping them repeatedly into an alcoholic solution of shellac. The skin thermopile was similarly protected against short circuiting by sweat. The adequacy of the insulation was proved by calibrating the thermopile both in salt solution and in distilled water.

The sensitivity of the apparatus above described was such that one millimeter deflection on the galvanometer scale indicated a temperature difference of about one-tenth degree centigrade between the two ends of the thermopile in the circuit.

For calibration, the unknown temperature terminals of the thermopile were bound with elastic about the bulb of a sensi-

tive thermometer, and this was immersed in a suspended test tube of distilled water or salt solution.

This test tube was again suspended in a beaker of water containing a stirrer. The temperature of the outer beaker was slightly raised at intervals, the water in the beaker and test tube stirred until a constant temperature had been reached, and the thermometer and galvanometer readings then taken. The calibration curves constructed from the data thus obtained were found to deviate appreciably, though very slightly, from straight lines. Temperatures were therefore taken from the curves directly.

Application of the thermopile terminals. The phase of the thermogalvanometric study of the skin and mucous surfaces which presented a new problem was that of applying the unknown temperature ends of the thermopiles. They had to be so fixed upon the site to be studied that they would remain in unchanged position, under constant and light pressure, and in such a way as not to interfere with the rise and fall of temperature in the surfaces under them in response to changing vasomotor conditions. The first two requirements were met by fastening the thermopile wires upon stiff carriers which we may designate as "applicators," and then, in the early work, fastening the latter to the appropriate surfaces by strips of adhesive plaster. Various applicators of carved wood and of wood padded with cotton covered with adhesive plaster were tried and rejected because they interfered with the normal loss of heat from the surfaces under them. Applicators satisfactory in all respects were finally made from galvanized iron wire. A medium size was used, such that it could be twisted and hammered into the required shapes, yet would bear considerable pressure without deformation. No. 13 wire proved most satisfactory.

The several applicators used in the experiments to be considered below are shown in Fig. 1 and Fig. 2. Each consists of a body along which the thermopile wires are strung and supports placed, and a tip just large enough to allow the three terminals of the thermopile to be twisted around it. The tip is so shaped as to conform to the contour of the surface against which it is to hold the thermopile terminals. The terminals, although insulated with shellac as described above, are sepa-

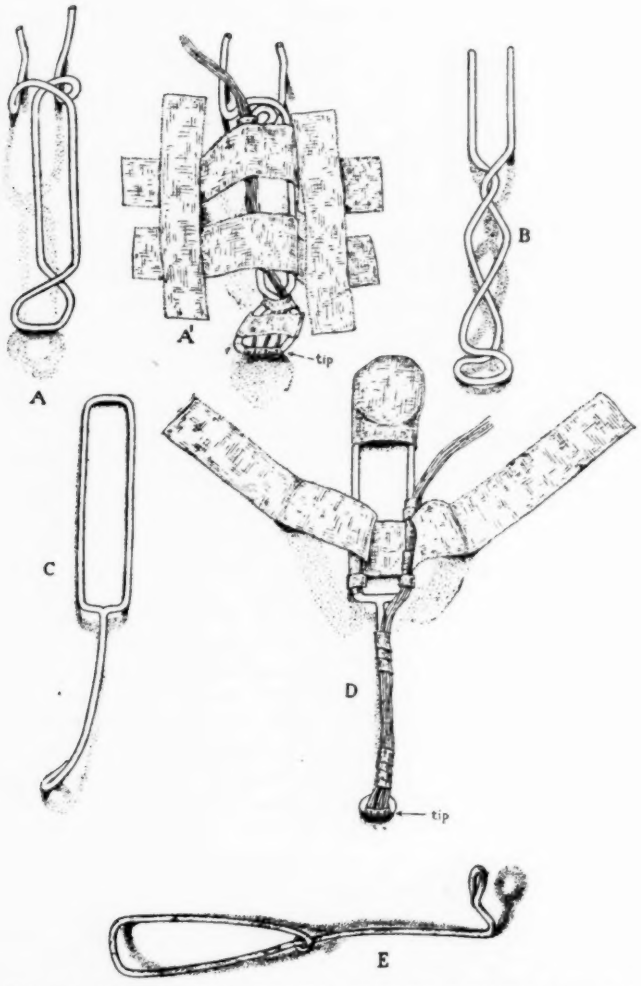


Fig. 1. Applicators: A, for skin; A', same, applied; B, for soft palate; C, for faucial tonsils; D, for oropharynx, ready for application; E, for nasopharynx.

rated from the metal tip by a single strip of adhesive plaster as a further safeguard against short circuiting. (See Fig. 1, A' and D, and Fig. 2, F.)

The skin applicators (Fig. 1, A and A') are so shaped as to form a bridge, resting stably on a support at either end, one of which is the tip, bearing the terminals. Across this raised bridge are placed the adhesive straps which hold the device in position on the skin. The tip rested usually either in the subject's supraclavicular fossa or on the forehead.

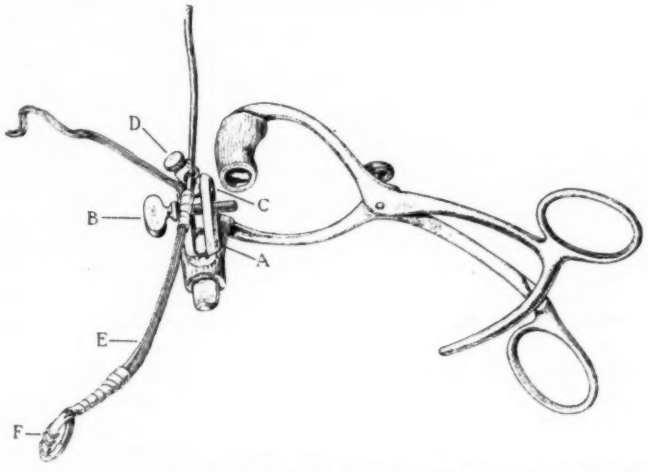


Fig. 2. Tonsillar applicator and holder: A and C, ball and socket joints made by metal spheroids and blades of head mirror; B, set screw for tightening joints at A and C; D, set screw for fastening applicator in holder; E, applicator; T, tip bearing thermopile terminals.

The mucous membrane applicators (Fig. 1, B, C, D and E) were slung in the subject's open mouth by a long adhesive strip (Fig. 1, D), which supported the body of the applicator, then passed up just in front of the corners of the mouth and was fastened on the subject's two cheeks. The tip of the applicator held the thermopile terminals against the particular site on the palate, tonsil or pharynx whose temperature changes were studied. The other end of the applicator projected out

of the subject's mouth and bore a small weight. Thus the whole device when in position constituted a lever whose fulcrum was the supporting adhesive strip, whose short arm was weighted and the tip of whose long arm held the thermopile end against the mucous surface.

In the experiments upon the faucial tonsils this method was much improved upon. Into one arm of a Doyen mouth gag (Fig. 2) a small brass sphere, A, was screwed. A second brass sphere bearing a groove closed by a set screw, D, was made. The two spheres were connected by means of the blades of an ordinary head mirror, C. The blades could be clamped stably upon the spheres by means of a second set screw, B. The applicator, E, so shaped as to have its tip fit against the tonsil, was held in place in its groove by the set screw, D. By varying the shape and position of the applicator and arranging properly the two joints at A and C, any desired application could be made. The subject's teeth were protected from the metal gag by rubber as shown in the drawing.

The applicator holder for the nasal cavity experiments consisted of a plate of strong but slightly flexible fiber board, about 1.5 mm. in thickness, so shaped that it could be firmly held between the subject's teeth, and cross hatched with a fine saw to prevent slipping, into which was screwed a metal sphere like that of Fig. 2, A, connected through metal blades to a second spheroid with groove and set screw, as in Fig. 2. The arrangement of the applicator and thermopile wires was like that of Fig. 2, except that the applicator was straight and its terminal loop for the thermopile tips was very small. The subject held his lips tight closed over the fiber board plate.

Arrangement of the subject: The experiments were performed in a constant-temperature room, kept, on the average, between eighteen and nineteen degrees centigrade. The subject entered the room undressed save for shoes and socks, but warmly wrapped in loose garments. Throughout an experiment he sat in unchanging position, tongue held flat on the floor of his mouth, and applicator in position. The sites on which the applicators were placed were of course never wrapped and were protected from direct chilling. The experimenter removed and reapplied the wraps without disturbing the subject. Chilling was effected by (a) removing the

wraps; or (b) unwrapping and applying cold wet towels to the subject's back; or (c) unwrapping and turning an electric fan upon the subject's back. The third method was found to be by far the most efficacious.

In the earlier experiments very considerable difficulty was experienced because of the necessity for swallowing the saliva and mucus secreted in excessive amounts under these circumstances. This difficulty was subsequently minimized by continuously evacuating the liquids in the mouth through a glass tube—the ordinary saliva ejector tube of the dentists—connected through rubber tubing with a suction pump on a water faucet.

Factors determining superficial temperature changes: The factors determining the temperature changes in the skin and mucous surfaces during the course of an experiment may now readily be understood. The skin is a surface constantly being heated from below by the circulating blood in the cutaneous vessels (and to a less extent by direct conduction of heat from the deeper tissues), and constantly losing heat by evaporation of moisture, and by radiation, conduction and convection to the cold air of the room to which it is exposed. Since the temperature of the room (and of the deeper body tissues) remains virtually constant throughout the experiment, the skin temperature depends primarily upon two variable factors, viz., (a) the blood temperature and (b) the amount of blood per unit of time which circulates through the cutaneous vessels. Of these the latter is incomparably the more important. For although a rise or fall in blood temperature would of course tend to effect a corresponding change in skin temperature, yet such blood temperature changes under the conditions of our experiments were found to take place only to a relatively slight degree. It is a fact of much greater moment that, as more blood circulates through the skin, the superficial temperature must rise, that as the cutaneous vessels are constricted the superficial temperature must fall.

For theoretical completeness, alterations in rate of evaporation of sweat must also be considered. However, with the sudden changes from warmth to chilling and vice versa used in our experiments, sweat evaporation changes must have played a small part; and whatever part they did play must have been

simply to make less striking the primarily important effects of vasoconstriction and vasodilation. For example, chilling the body surface was found experimentally to cause a sharp fall in superficial temperature due to reflex cutaneous vasoconstriction. But this same chilling would decrease the production of sweat and the rate of sweat evaporation and hence tend to prevent the fall in temperature incident to vasoconstriction; and similarly for warming the body, mutatis mutandis.

Also in the mucous membranes the factor of prime importance in effecting temperature changes is that of vasomotor tone. Blood temperature, because of its relative constancy, is of minor interest. Room temperature, rate of evaporation of liquids and conduction of heat to the surface from deeper tissues are all virtually constant throughout the experiment, and so require no consideration. A third factor of consequence operating here must, however, be considered, namely, changes in rate and volume of respiration. We may assume the mucous membrane, warmed by the circulating blood, to be losing heat in three ways: (a) by direct radiation through the open mouth, (b) by inhalation of cool air and exhalation of warm air in respiration, and (c) by conduction down a thermal gradient established through the air in the mouth, and especially along the metal applicator, to the cold room outside. From what has been said above, it is evident that the rate of heat loss by (a) radiation, and (c) conduction, was kept virtually constant throughout each experiment. In all the experiments cited below (b) respiration was carefully controlled—rate of breathing in time with a metronome, and depth by the use of a thoracic and abdominal pneumograph writing on a smoked drum in sight of the subject.

Finally, the effects of air currents and eddies in the experimental room must be considered. Although the sites of application of the thermopiles were protected from the direct draft of the fan, minor currents and eddies were necessarily set up in the small closed room, and the direct cooling effect of these upon the exposed skin could not be eliminated. This direct cooling, as closely as we have been able to estimate it, probably amounted usually to between one-third and one-half of the observed skin temperature fall. The curves should be studied with this correction in mind. On the other hand, it is

obvious that in experiments in which the mouth was closed and the applicator upon the pharyngeal wall, currents in the room could not have entered at all into the depression of mucous membrane temperature. Similarly with the applicator in the nasal cavity and nose breathing, or on the palate or pharyngeal wall, even with the mouth open, direct cooling by air currents in the room have entered but slightly or not at all into the observed mucous membrane temperature fall. The effect of the air currents, then, has been to make appear less striking in comparison with those of the skin the vasoconstrictor reflexes of the mucous membranes with chilling of the body surface.

The thermopiles when applied to such surfaces under the conditions described do not record precisely the absolute temperatures of the surfaces as they would in the absence of the thermopiles. However, we believe that this method does afford an accurate and sensitive means of recording superficial temperature changes, and, through these, states of vasomotor tone, and it is with these that we are concerned. Measurement of the absolute mucous membrane temperature, if desired, could be effected by a modification of the method used for the skin by Benedict, Miles and Johnson (1919).

Control Experiments.—In order to determine the validity of mucous membrane temperature as a criterion of vasomotor tone it was necessary to study changes effected in respiration, blood pressure and blood temperature by the conditions of our experiments. Without going into detail, the results of these control observations may be briefly summarized.

Chilling the body surface has, both in our controls and in animal experiments (Ansiaux, 1889, p. 569) increased the volume of respiratory change, and this in turn often depressed mucous membrane temperature. It was for this reason that control of respiration by metronome and pneumographs was necessary.

Blood pressure was not, in the two trials made, significantly altered by chilling. Animal experiments have shown an initial rise, followed, in instances of extreme chilling with depression of blood temperature, by a progressive fall (Marchand, 1908, p. 125, and Ansiaux, 1889). The depression of superficial

temperature observed with cutaneous chilling was therefore not the result of lowered blood pressure.

Blood temperature, as has been said, underwent only slight alterations during the course of our experiments. So efficient is the heat regulating mechanism in man, indeed, that during chilling the blood temperature rose very slightly, to undergo a slight fall on cessation of chilling. (Fig. 3.) Liebermeister (1860) found essentially similar changes in axillary temperature with chilling of the skin.

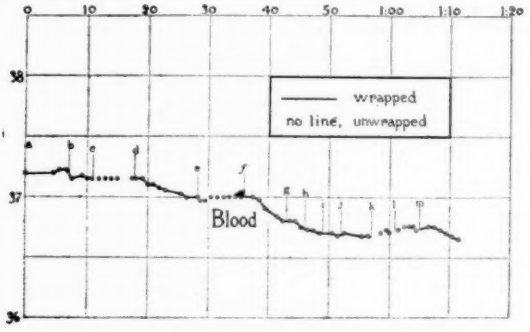


Fig. 3. Blood-temperature control: (a) electric light is reflected on thermometer; (b) light removed; (c) unwrapped; (d) wrapped; (e) unwrapped, fan on; (f) fan off, wrapped; (g) muscles of subject under tension; (h) subject feels warm; (i) subject sits comfortably, skin seems flushed; (j) subject feels cold; (k) unwrapped, cold towels to back; (l) fresh cold wet towels to back; (m) dried and wrapped.

Vasomotor Reactions to Chilling.—Temperature changes in the skin and exposed mucous membranes were thus established as valid criteria, under the conditions of our experiments, of vasomotor tone. The graphs to follow actually show surface temperature changes; their significance is of alterations in blood supply. Obviously, fall in temperature means reflex vasoconstriction, a rise, vasodilation.

The vasomotor responses to chilling of a distant area of the body surface exhibited in the exposed skin of the forehead and of the mucous membrane of the soft palate and oropharynx, respiration and other conditions being carefully controlled as described above, may readily be made out from Fig. 4.

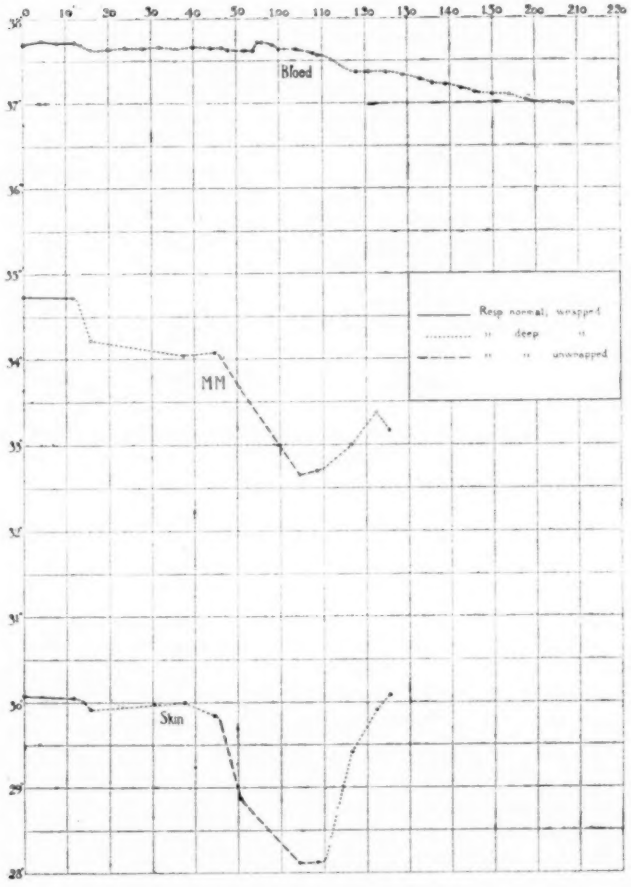


Fig. 4. Effects of chilling body surface, respiration controlled. Composite graphs of four experiments (temperatures of skin and mucous membranes of oropharynx and soft palate), and two experiments (blood temperature). Subject chilled by unwrapping, with draft of electric fan on back.

The two lower curves of this figure are composite graphs of four experiments of similar pattern. The points chosen for plotting are: The first and last readings of each experiment, the readings immediately before and after each change in experimental conditions, and the first point of maximum response of the mucous membrane to changed conditions; each point graphed is the average value of the corresponding point of the four experiments. Time is plotted on the horizontal axis, temperature on the vertical; the space between the ruled lines represents ten minutes on the abscissa, one-half degree centigrade on the ordinate. The character of the lines connecting the points gives the nature of the experimental conditions, as indicated in the legend.

While respiration is quiet and the subject wrapped, mucous membrane and skin temperatures remain constant. Deepening of respiration affects only inconsiderably the skin temperature, but causes a depression of mucous membrane temperature amounting to .68° C., which reaches its maximum after 25.4 minutes, and then, during the remaining 8.5 minutes before chilling begins, remains virtually constant.

The subject was chilled by unwrapping him and directing the draft of an electric fan against the lower thoracic region of his back. With the start of this process, a marked depression both of mucous membrane and of skin temperature begins. The maximum fall of mucous membrane temperature is 1.42° C., reached in 18.4 minutes. The synchronous point on the skin curve represents a drop of 1.73° C. The skin curve falls away a little more sharply than the mucous membrane curve. However, even if the vasoconstriction in skin and mucous membrane were to follow an identical course, we should expect, on mechanical grounds, this difference in the curves; for the more exposed forehead would of course lose heat more readily than the mucosa of the palate and pharynx.

When it was seen the mucous membrane temperature had ceased to fall, the fan was turned off and the subject again wrapped. Here a disparity in the behavior of skin and mucous membrane vessels appears. The skin temperature climbs steeply and surmounts the level at which chilling began. The skin "reacts," as is commonly said. But the mucous membrane temperature rises only .73° C. Its maximum recovery is

reached after 12.7 minutes and is .69° C. below the last point before chilling. During the remaining 3.5 minutes of observation it falls .21° C.

No explanation in mere physics is to be found for the mucous membrane temperature remaining depressed; if its vessels returned to the same tone as before chilling, the temperature curve should return to control level. Yet this same incomplete recovery after chilling was noted in all the crucial experiments upon soft palate and pharynx, alike in the early determinations with respiration uncontrolled and the final ones with respiration controlled. Measurement of the respiration records for the four experiments graphed in Fig. 4 was made, and the mean figure arrived at for respiratory amplitude before chilling differed from that after chilling by only a fraction of 1 per cent. In those experiments in which respiration was slightly deeper before as well as in those in which it was a few per cent deeper after chilling, the failure of the mucous membrane temperature to regain its former level is usually evident. We are forced to conclude, therefore, that the vasoconstriction and ischemia reflexly produced in the palatine and pharyngeal mucous membrane by chilling the body surface persist in part for some time at least. The skin in our experiments has tended more completely to regain its blood supply. The tonsils have tended to regain their blood supply even more completely than the skin, in some instances actually becoming hyperemic on rewarming (Grant, Mudd and Goldman, 1920).

The uppermost curve in Fig. 4 is a composite of two blood temperature control experiments which followed the same pattern as the two lower curves. For discussion, see above.

A few experiments, illustrating typical reactions in the several regions of the nose and throat, may now be briefly considered:

Experiment A: M. M. thermopile on anterior half of soft palate. Skin thermopile on forehead. Respiration, 18 per minute. Mouth open, nose breathing. Thoracic and abdominal pneumographs. Room temperature, 17.9° to 18.8° C.; time, 3.55 to 5:16 p. m.

Experiment A from 0:00 to 0:50, shows the typical picture described for the composite graph above, save that the an-

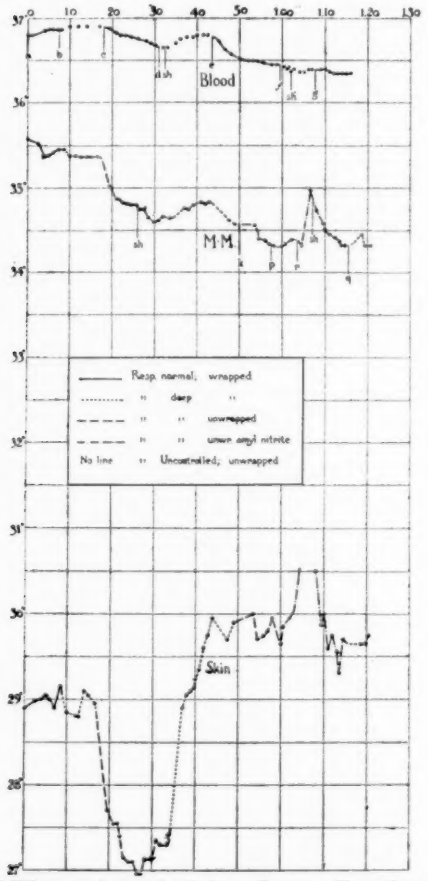


Fig. 5. Chilling and amyl-nitrite effects. Experiment A (temperatures of skin and mucous membrane of soft palate), and experiment K (blood temperature): (a) wrapped; (b) unwrapped; (c) wrapped; (d) unwrapped, fan on back; (sh) shivering begins; (e) fan off, wrapped, shivering stops; (f) unwrapped, cold, wet towel to back; (sh) is shivering; (g) dried and wrapped; (k) cold, wet towels to feet, fan on feet; (p) more cold water poured on towels around feet; (r) respiration is exaggerated; (q) fan off, feet dried and wrapped.

terior palatine mucous membrane is not affected by deepening respiration. At 0:50 the subject's feet were exposed, wrapped in cold wet towels, and the electric fan turned on them. This seems to have been without effect upon the forehead, but was followed apparently by a slight depression, .29° C. of mucous membrane temperature. This effect was not sufficiently definite to warrant much emphasis, but is at least suggestive in view of the possible efficacy of wet feet in exciting colds.

Administration of amyl nitrite at 1:03, while the feet were still being chilled, was followed by a steep rise in mucous and skin temperatures with quick return to normal. The break in the skin curve is meant to indicate that it may have risen about 30.5° C. in the interval, 1:02 to 1:08, during which no skin readings were made.

The uppermost curve in Fig. 5 is a blood temperature control.

Experiment B: M. M. thermopile on posterior wall of oropharynx. Skin thermopile on forehead. Respiration, 18 per minute. Nostrils plugged with cotton, mouth breathing. Thoracic and abdominal pneumographs. Room temperature, 19.0° to 20.6° C.; time, 10:11 p. m. to 12:33 a. m.

The curve of Experiment B (Fig. 6) shows the pharyngeal mucous membrane reacting in essentially the manner indicated in the composite graph, and shown also for the palatine membrane in Experiment A. The difficulties in technic are considerably greater with the thermophile applied to the pharynx than to the palate, however, and the curve is never so smooth. The effects of moving the pharyngeal wall against the thermopile terminals by coughing, swallowing or clearing the throat, is shown at 0:27, 0:50.5 and 1:41. Presumably two factors play a part in the sudden rise in temperature produced; the momentarily increased pressure between terminals and mucous membrane slightly increased, mechanically, the temperature of the former; the painful mechanical irritation of the mucosa by the metal terminals and applicator probably caused a transient blush. The rises in temperature, which took place before chilling, although apparently elicited by less movement, were much more marked than that which occurred

during the active vasoconstriction with chilling—1.77° and 2.69° C., as compared with .98° C.

The effect upon skin temperature of inhaling amyl nitrite is shown (2:17). A rise of .5 C. is again produced.

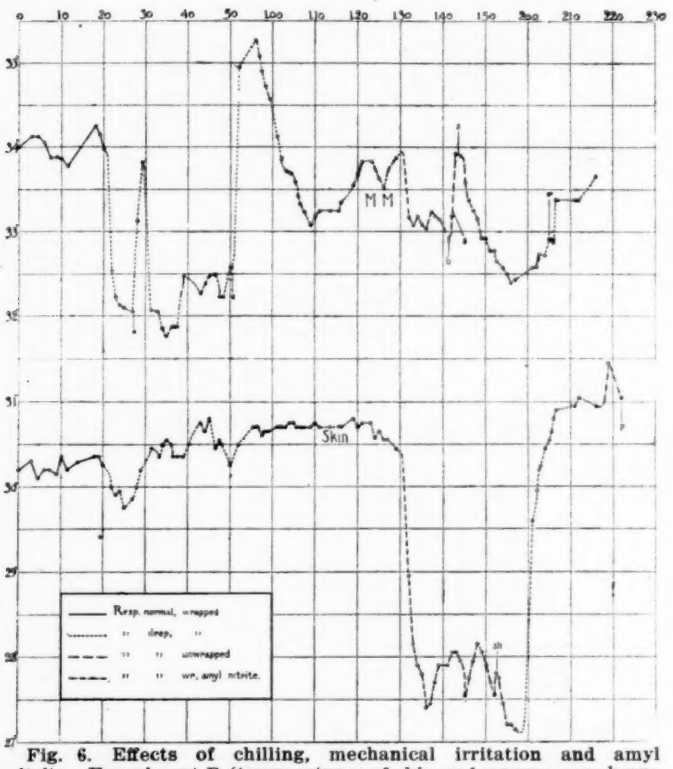


Fig. 6. Effects of chilling, mechanical irritation and amyl nitrite. Experiment B (temperatures of skin and mucous membrane of oropharynx): (a) coughs and clears the throat; (b) clears throat and swallows; (s) swallows; (sh) begins shivering; (r) misses several respirations; (p) exact time of point (p) not known; (d) coughs and clears throat.

It is to be remembered that, since the mucous membrane and skin curves of each experiment are synchronous, the anno-

tations, although drawn in as though applying only to one curve, apply equally to both.

Experiment C: M. M. thermopile on posterior wall of nasopharynx. Skin applicator on forehead. At first, nostrils

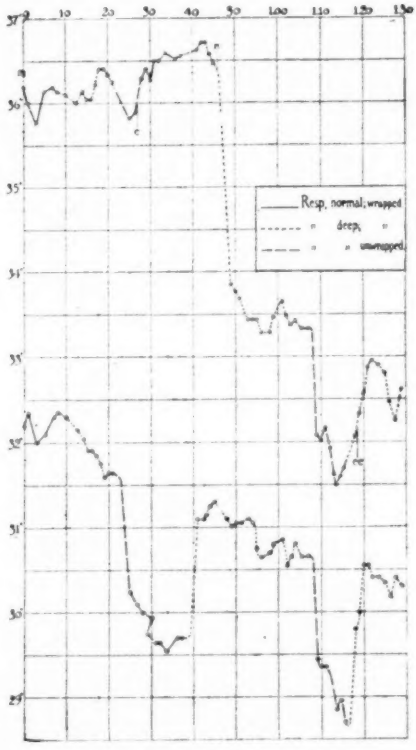


Fig. 7. Chilling effect. Experiment C (temperatures of skin and mucous membranes of nasopharynx): (m) nostrils plugged, breathing through mouth; (c) coughs; (n) plugs removed from nostrils, breathes through nose; (cc) coughs three times.

plugged, breathing through mouth; later, breathing through nose, mouth open. Respiration, 18 per minute. Thoracic and

abdominal pneumographs. Room temperature, 15.7° to 16.9° C.; time, 4:15 to 5:45 p. m.

With the anterior nares plugged and the soft palate raised in mouth breathing, the nasal chamber was virtually a closed cavity, whose temperature did not vary with the rate of blood flow through its walls. Correspondingly, the mucous mem-

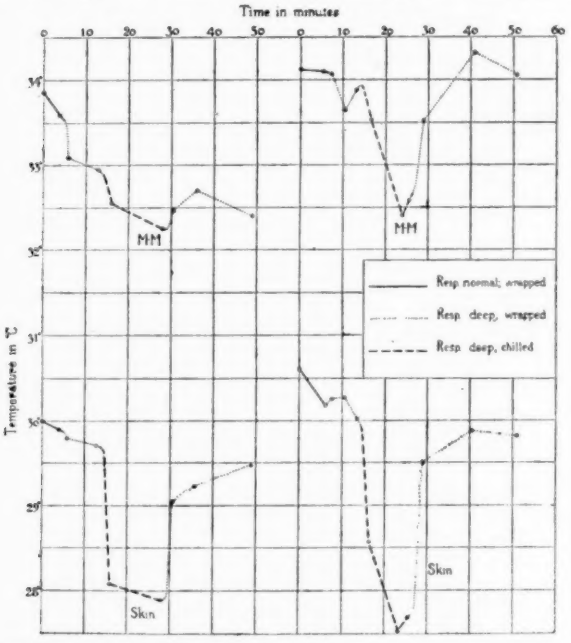


Fig. 8. Reactions to chilling and to rewarming. On left, composite of three experiments. (Temperatures of skin and mucous membrane of soft palate and oropharynx. On right, composite of four experiments. Temperatures of skin and mucous membrane of faucial tonsils.)

brane curve (Fig. 7) showed no certain change when, at 0:08.5, respiration was deepened, nor at 0:22, when the subject was unwrapped and chilled with the electric fan. The skin curve, on the other hand, dropped off characteristically, to recover when the subject was rewrapped.

At 0.46 the nostrils were unplugged and nose breathing began. The nasopharynx at once came into free communication with the outer air, and was cooled by each respiration, and became dependent upon its blood supply for maintenance of its temperature. When equilibrium had been reached, the subject was again, at 1:07.5, unwrapped and chilled with the fan. Mucous membrane and skin temperatures fell together, the former reaching a maximum depression of 1.83° C. in six minutes, the latter of 1.95° C. in eight minutes. After rewrapping at 1:16, the mucous membrane temperature rose in six minutes to a maximum point .38° below the control level, then fell slightly; the skin temperature mounted in four minutes to a maximum only .10° below control level.

In the experiments of the first series a single exception to the rule that mucous membrane temperature, upon wrapping after chilling, does not regain its original level, was found in the experiment performed upon a faucial tonsil. In this case mucous membrane temperature rose well above control level. With this idea of determining whether or not this behavior was characteristic, and because of the peculiar importance of the tonsils as a site of infection, a second series of experiments was performed with especial reference to the tonsillar reactions. These confirmed the earlier observation.

The curves on the right of Fig. 8 are a composite of four experiments upon tonsil and skin; on the left are shown for comparison composites of two experiments with the soft palate and one with the oropharynx as mucous membrane site of application.

In the tonsillar curves chilling begins at 0:15; mucous membrane and skin temperature fall away steeply together. Upon rewrapping at 0:27 skin temperature returns not quite to control level, tonsillar temperature considerably above it. In the palatine pharyngeal curve, on the other hand, the characteristic failure to regain normal relaxation of vasomotor tone after chilling is again evinced.

Experiment D: M. M. thermopile on left faucial tonsil. Skin application on forehead. Nostrils plugged, breathing through mouth. Respiration, 14 per minute. Thoracic and abdominal pneumographs. Room temperature, 17.3° to 19.45° C.; time, 11 a. m. to 12 m.

Experiment D illustrates the same reactions as the composite. With the beginning of chilling at 0:12 skin and mu-

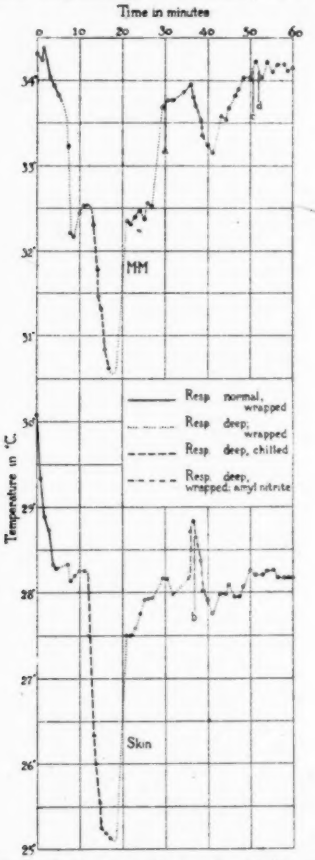


Fig. 9. Chilling, recovery and amyl nitrite reactions. Experiment D (temperatures of skin and mucous membrane of faucial tonsil): (a) applicator seen to be all right; (b) flush fading; (c) respiration shallow; (d) breathes deeper.

cosa lose heat together, to regain it on rewrapping at 0:17.5. By 0:34.5 the mucous membrane temperature had risen to

33.85° C., 1:32° above the level at which chilling began. At 0:35 an ampule of amyl nitrite is inhaled. The vasodilation in the already hyperemic tonsillar mucous membrane was evidently insufficient to counterbalance the effect of lowered gen-

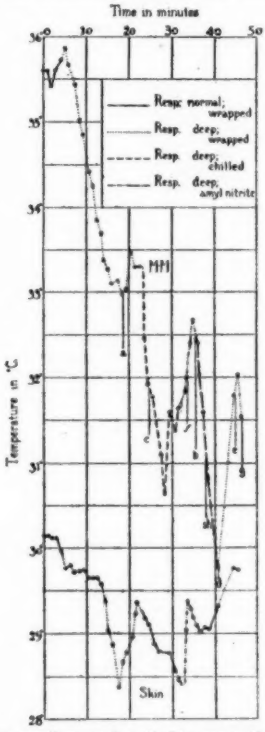


Fig. 10. Chilling and amyl nitrite reactions. Experiment E (temperature of skin and mucous membrane of faucial tonsil): (a) clears throat; (c) coughed; (f) face flushed; (b) flush passing, amyl nitrite taken away; (sh) shivering; (d) clears throat; (e) respiration too shallow, deepened; (g) subject fainted.

eral blood pressure, so that a fall in temperature resulted. The skin temperature on the other hand, rose characteristically with the amyl nitrite. As the flush passed, skin temperature fell and mucosal temperature rose to their former levels.

Experiment E: M. M. thermopile on left faucial tonsil. Skin applicator on forehead. Nostrils plugged; mouth breathing. Respiration, 14 per minute. Thoracic and abdominal pneumographs. Room temperature, 17.5° to 18.55° C.; time, 10:56 to 11:43 a. m.

Figure 10 with the beginning of chilling shows the usual temperature fall; the recovery curve was terminated prematurely by the subject unfortunately fainting. Amyl nitrite was administered during chilling at 0:32.5. Vasodilation here evidently more than counterbalanced blood pressure fall, for the skin and mucous membrane temperatures each rose steeply.

The reactions of the nasal cavity have recently been found to be similar in quality to those of the oropharynx and nasopharynx, but quantitatively much more striking. Twelve experiments have been performed on seven different subjects of Aryan, Semitic and Mongolian stock. The sites tested are the nasal septum, inferior and middle turbinates, and inferior and middle meati, all, because of difficulty in application farther back, in the anterior half of the nasal cavity.

In every case chilling of the body surface has resulted in reflex vasoconstriction in the nasal mucous membrane, rewarming in vasodilation. Striking vasodilation occurs on inhaling amyl nitrite.

The reflex to the nasal mucous membrane showed a lower threshold than the corresponding reflex to the skin of the forehead. Merely unwrapping the subject in a room of 14.0° to 18.0° C. in a number of instances resulted in no change or a very slight fall in skin temperature and a fall in mucous membrane temperature of 1.5° to 2.0° C., or even more. A similar though smaller fall in mucous membrane temperature, unaccompanied by a skin temperature depression, has been observed also on unwrapping the subject with the thermopile tips on the palate, tonsil and nasopharyngeal wall.

Similarly the threshold of the chilling vasoconstrictor reflex to the forehead has been found to be higher than that to the skin of the trunk.

Application to the nasal mucosa of the thermopile terminals was extremely irritating and resulted in discharge of considerable amounts of clear mucus. The discharge was both on the

side of the cavity in which application was made and on the opposite side, although more abundant on the former.

It seemed to be little if at all affected by the marked shrinkage of the mucous membrane during chilling. In three experiments the subject thought secretion was slightly

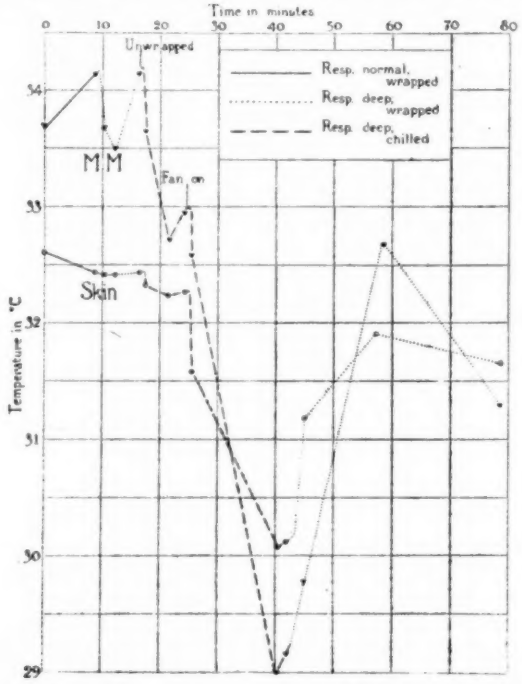


Fig. 11. Reactions of nasal cavity to chilling and rewarming of body surface. Composite graph of seven experiments. (Temperatures of skin and of mucous membrane of nasal septum, inferior turbinates and middle meatus, in anterior half of nasal cavity.)

more copious during chilling; in one he thought it slightly less. In others no change in secretion was noted. These last observations bring out two facts:

1. Discharge from the nasal cavity may be reflex and may occur in regions of the nose not directly irritated.

2. Rhinorrhea is not necessarily accompanied by vasomotor turgescence in the nasal cavity.

The nasal vasomotor reactions are illustrated by Figs. 11 and 12.* (Footnote below.)

Figure 11 is a composite of seven experiments of similar pattern performed upon four subjects. The sites used were the right and left sides of the nasal septum, the right and left inferior turbinates, and the left middle meatus.

A transitory fall of 0.6° C. in mucous membrane temperature followed deepened respiration. On unwrapping the subject, mucous membrane temperature was depressed 1.4° C.; skin temperature synchronously only 0.2° C. Turning an electric fan on the subject's lower back resulted in a further mucous membrane fall of 3.7° C. and a skin fall of 2.1° C. Maximum recovery for mucous membrane was 3.7° C. (71 per cent); for skin the corresponding recovery was 1.8° C. (77 per cent).

Experiment F: M. M. thermopile on anterior end of left inferior turbinate. Skin applicator on forehead. Mouth closed; nose breathing. Respiration, 14 per minute. Thoracic and abdominal pneumographs. Room temperature, 16.0° to 17.0° C.; time, 1:14 to 2:48 p. m.

Figure 12 illustrates in an individual experiment the reactions brought out in the composite. With unwrapping at :12.0 the skin temperature is not depressed for two and a half minutes; the mucous membrane temperature in like time falls 1.6° C. The pronounced drop in both mucous membrane and skin curves with fan on is interrupted by a sharp rise following amyl nitrite administration at 0:23.25, amounting, in the case of the mucosa, to 3.9° C., in that of the skin to 1.1° C. After unwrapping, the mucous membrane temperature in this experiment slightly more than regained its level of before chilling (in most of the experiments it remained depressed). Inhalation of amyl nitrite in this flushed condition of the mucous membrane resulted in a momentary depression of 0.2° C., followed by a rise of 0.6° C. Skin temperature rose 1.0° C. approximately as before. The experiment ends with a pro-

*For detailed account, see Mudd, Grant and Goldman (1921).

found vasoconstriction of mucous membrane and skin vessels incident on a second chilling with the fan.

Checking of quantitative results by qualitative observations of redness. The experimental analysis outlined above ade-

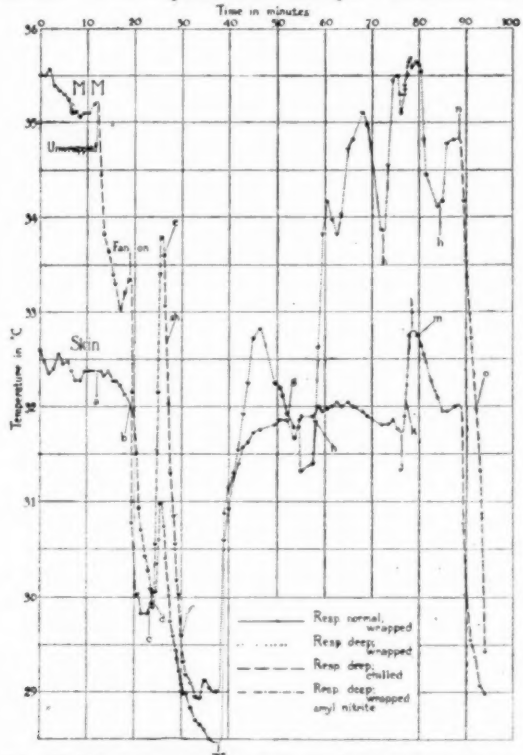


Fig. 12. Chilling, rewarming and amyl nitrite reactions. Experiment F (temperatures of skin and mucous membrane of left inferior turbinate, anterior end). (a) Subject unwrapped; (b) fan on; (c) amyl nitrite inhalation begins; (d) face has begun to flush; (e) flush fading, stops inhaling; (sh) shivers; (f) is shivering; (wr) fan off, warmly wrapped; (g) m. m. applicator feels to subject to be in correct position; (h) m. m. applicator readjusted so that subject can feel pressing against turbinate; (j) amyl nitrite administered; (k) face flushed; (l) stops inhaling amyl nitrite; (m) flush fading; (n) unwrapped, fan; (o) is shivering hard.

quately proves, it seems to us, that chilling of the body surface reflexly produces vasoconstriction in the vessels supplying the normal mucous membranes of the palate, tonsils, oropharynx and nasopharynx, and of the nasal cavity. However, in order to secure still further corroboration, observations of the appearance of the mucous membranes and their blood vessels were made.

Twelve experiments were performed. Of the five observers who noted the appearance of the buccal and oropharyngeal membranes before and after direct exposure of those membranes to cold air, all were of the opinion that, with the direct chilling, blanching occurred. Of the six observers who noted the appearance of the soft palate and the seven who studied the normal oropharynx before and after chilling of the body surface, all said that the membranes paled while the skin was being chilled. Only one observer specifically studied the reaction of the tonsils. He said that they blanched during the skin's chilling. Of the three observers who watched the changes following rewrapping, one simply said that reddening occurred; two said that reddening occurred only to a slight extent.

The first point, i. e., the response of the mucous membranes to direct chilling, was not suitable to thermogalvanometric study. The observation that blanching occurred is, however, in harmony with observations upon direct cooling of the nasal mucous membrane made by Cocks (1915). (For bibliography on effect of cold on circulation of immediate region to which it is applied, see Nägelsbach, 1920). The other points observed are wholly in accord with the quantitative studies.

Results in harmony with our own have been published by Tschalussow (1913), who used the nose with posterior nares packed, as a plethysmographic chamber and studied the results of chilling the feet and lower legs and of other sensory stimulation, and by Galeotti (1920), who studied the effect upon the temperature of the expired air of cutaneous chilling and warming. Tschalussow found that in a human subject emersion of the feet and lower legs in water at 18° C. caused a marked decrease in the volume of the nasal cavity; electrical stimulation, needle pricks and scratching the

skin caused vasoconstriction also, but to a less degree. Galeotti (1914) found that the temperature of the expired air is depressed 1° to 2° C. by cutaneous chilling, raised correspondingly by warming. In explanation of this, he advanced the somewhat improbable hypothesis of pulmonary vasoconstriction.

Vasomotor reactions of abnormal tissues: (a) Reactions in chronic inflammatory throats: One new point of great interest was brought out by the observation experiments in which the pillars and tonsils were seen to blanch with the cutaneous chilling. The pharynx of this same subject was much injected. He gave a history of having noticed a sore throat about a week before, which he thought had cleared up; the night before the experiment he had driven an open machine without an overcoat, and his sore throat had returned. The diagnosis was chronic catarrhal pharyngitis with pustules. This inflamed throat did not pale with the rest of the mucous membrane, but, if anything, its injection was intensified by chilling the body surface.

In a thermogalvanometric experiment upon a case of chronic pharyngitis of two years' standing, a similar reaction resulted (Fig. 13).

History.—Began smoking in 1915; used about four cigarettes daily. In 1916, began smoking fifteen to twenty cigarettes daily: about this time pharyngitis began. Since has smoked eight to ten cigarettes daily. Treated April, May and June, 1917, Johns Hopkins dispensary, with argyrol, etc. No improvement. Treated twice a week with argyrol and silver nitrate, November and December, 1918, in St. Louis. No improvement. Told smoking was probable cause, and if would stop smoking throat would get well. Conditions unchanged August 2, 1918, when experiment performed.

Experiment G: M. M. thermopile on inflamed posterior wall of oropharynx. Skin thermopile on forehead. Respiration, 13 per minute. Nostrils plugged; mouth breathing. Thoracic and abdominal pneumographs. Room temperature, 18.7° to 19.5° C.; time, 10:10 to 11:35 p. m.

The skin curve in Fig. 13 is typical. The mucous membrane temperature shows the fall with deepened respiration which of necessity would follow inhalation into the pharynx through

the open mouth of increased volume of cold air. However, with chilling, 0:18.5 to 0:42, the mucous membrane temperature, instead of dropping with the skin temperature, shows a slight transient rise. The shape of the curve, reaching its height in the middle of the period of chilling and then slowly sinking, apparently uninfluenced by the cessation of chilling, suggests that it records some slight changes in local vasomotor tone quite independent of the cutaneous chilling, or

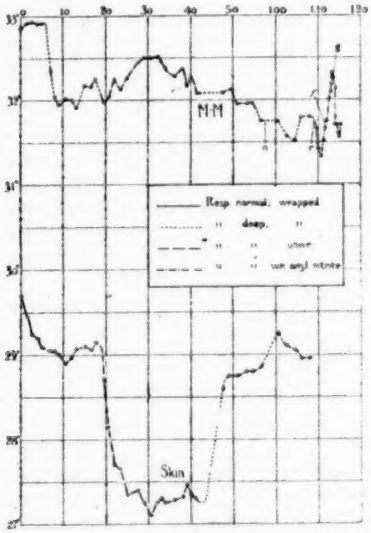


Fig. 13. Chilling and amyl nitrite effects upon chronically inflamed oropharynx. Experiment G (temperature of skin and mucous membrane of oropharynx): (n) plugs pulled from subject's nose, begins nose breathing; (r) respiration suddenly deepened; (f) face flushed; (g) flush passing, respiration still exaggerated.

alterations in general blood pressure, or some slight accidental change in experimental conditions. At all events, there is no questioning the fact that the normal reflex vasoconstriction is absent.

Inhalation of an ampule of amyl nitrite (1:08 to 1:09.5) was followed by characteristic vasodilation. Measurement of the respiration record shows breathing to have been suddenly

deepened at 1:09 (Fig. 13, r) and to have maintained itself abnormally deep until 1:14.5, when the subject could no longer maintain the slow rhythm, and respiration became quick and shallow. The preliminary fall of mucous membrane temperature from 1:09 to 1:10.5 was doubtless due, therefore, to deepened respiration and a fall in general blood pressure; the rise from 1:10.5 to 1:13.25 was unquestionably due to local vasodilation and occurred in spite of deepened respiration and lowered blood pressure.

Amyl nitrite causes vasodilation by direct action upon the smooth muscle of the blood vessel walls. This typical dilator response of the inflamed throat to amyl nitrite shows, therefore, that the vessel walls are capable of reacting normally. The typical skin curve would indicate proper functioning on the part of the afferent and association elements of the reflex arc. This failure of normal reaction to cutaneous chilling, in so far as conclusions can be drawn from a single experiment, must then be referred to the motor elements of the reflex arc, and probably has its seat in or near the inflamed mucous membrane.*

Reaction to amyl nitrite of an acute inflammatory palate: Experiment H: M. M. thermopile upon the intensely injected soft palate. Acute pharyngitis and tonsillitis. Respiration uncontrolled. Mouth breathing (except 0:00 to 0:23).

At 0:10.5 (Fig. 14) subject inhaled by mouth an ampule of amyl nitrite. A steep fall of mucous membrane temperature, amounting to 2.69° C. followed. The minimum temperature was reached in 13.5 minutes, and was followed by a rise of 2.56° C., attained in four minutes.

Evidently the vessels of the inflamed membrane were practically maximally dilated. The temperature change observed was therefore the result of the increase in depth of respiration and the depression of general blood pressure.

---

*This experiment is included as suggestive merely, not conclusive; for in later work it was found that a normal throat which ordinarily responded to chilling by reflex vasoconstriction would occasionally fail to exhibit that response. The explanation seemed to be usually or always that excessive swallowing and resultant traumatization of the pharynx occurred during the period of chilling, with consequent dilation of the vessels, as shown in Fig. 6. Such may possibly have been the case in this experiment.

Reflex reactions of scar tissue to chilling:

Experiment I: Keloid removed from chest wall August 24, 1918. Experiment performed September 25, 1918. Scar at that time 2.5 by 1 cm.; red; covered with epithelium. First thermophile on normal skin of chest near scar. Second thermopile on scar. Room temperature, 21.35° to 21.6° C. (See Fig 15, curves on left.)

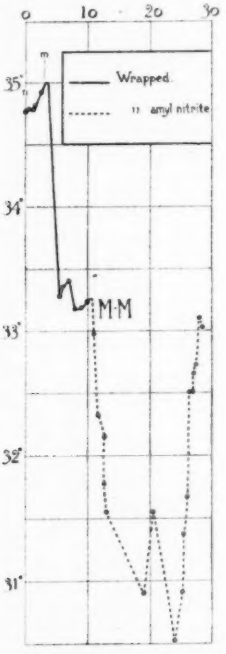


Fig. 14. Effect of amyl nitrite upon acutely inflamed soft palate. Experiment H (temperature of mucous membrane of soft palate): (n) breathing through nose; (m) changes to mouth breathing.

The subject sat wrapped from 0:00 to 0:11.5; the sites of application of the thermopiles were of course freely exposed. At 0:11.5, the subject was bared from the waist up, and chilled with ice bags to her back. Skin and scar temperatures both fell sharply. The scar temperature reached a maximum de-

pression of .90° C. in 1.0 minute, the skin of 1.12° C. in 4.5 minutes. At 0:17.5, the subject gasped and heaved her chest. Possibly as a result of mechanical irritation, the scar temperature at once rose, although skin temperature was not affected. At 0:20.75 the subject stood up to wrap herself, and may have disturbed the position of the scar applicator, al-

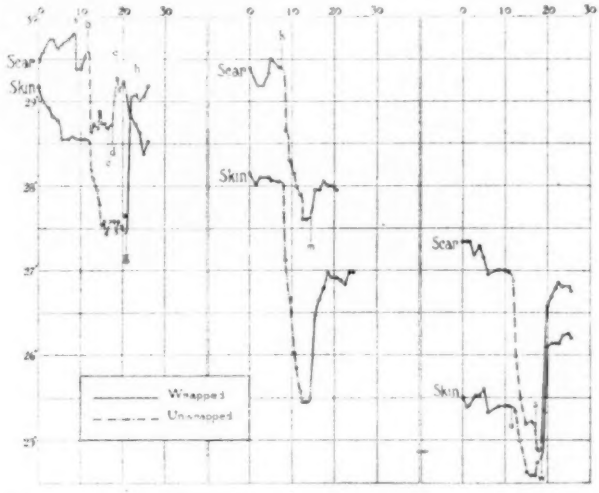


Fig. 15. Reflex effects of chilling on scar tissue. Experiments I, J and K (temperatures of scar and contiguous skin). Experiment I: (a) subject moves, sighs, etc.; (b) subject bared from waist up; ice bags to back; (c) gasps; (d) gasps, heaves chest; (g) wrapped (subject stood up to wrap self; when she sat down again the skin applicator was found to have tilted; the scar applicator seemed all right, but it also had probably moved somewhat); (h) heaves sigh. Experiment J: (k) body bared from waist up, no fan or icebag used; (m) wrapped. Experiment K: (u) body bared from waist up, fan on back, hairs on forehead not disturbed at all by draft; (s) shivers; (w) fan off, wrapped.

though no displacement was visible. After wrapping, the skin temperature rose typically, the scar temperature fell.

This experiment on new scar tissue shows, certainly, reflex vasoconstriction in response to chilling. To what degree the later atypical behavior of the scar temperature actually rep-

resents its vasomotor reactions and to what the failure of the subject to cooperate, it is difficult to say.

Experiment J: Radical operation June 7, 1918, for carcinoma of breast. Experiment performed September 23, 1918. First thermopile on normal skin near scar. Second thermopile on red scar, covered with epithelium, circular, about 2 cm. in diameter, over site of amputated breast. Sites of application exposed throughout experiment. Room temperature, 15.65° to 16.35° C. (See Fig. 15, middle curves.)

The subject was chilled at 0:07.5 merely by unwrapping in the cold room. Scar temperature dropped 1.80°C. within 5.0 minutes; skin temperature, 2.63° C. within 5.0 minutes. Upon rewrapping at 0:14.5, scar temperature rose .45° C. in 3.0 minutes; skin temperature, 1.54° C. in 4.0 minutes.

Experiment K: Admitted to hospital, February 1, 1918, with history of having ulcer on forehead for a year. Diagnosis: Syphilitic ulcer. Slow improvement under specific treatment. June 21, 1819, skin graft to ulcer from leg. Favorable. Discharged July 7, 1918. Experiment performed September 12, 1918. Scar about 5 cm. in diameter, red, covered with thin epithelium. First thermopile on normal skin near scar. Second thermopile on scar. Room temperature, 17.8° to 17.95° C. (See Fig. 15, curves on right.)

At 0:11.5 the subject was bared from the waist up, and an electric fan turned on her back. Hairs over her forehead were not disturbed; thus the sites of application were not seriously cooled by draft. The scar temperature fell 2.09° C. in 6.0 minutes, the skin 0.82° in 4.5 minutes. Upon wrapping at 0:18.5, scar temperature rose 1.96° C. in 4.0 minutes; skin, 1.55° C. in 6.5 minutes.

These reactions would seem to explain the cyanosis of fresh scars during cutaneous chilling. The arteriolar constriction doubtless renders the flow of blood through the wide capillary network scant and sluggish, thus allowing unusually complete absorption of oxygen from the oxyhemoglobin.

AFTER-EFFECTS OF CHILLING EXPERIMENTS OF SERIES OF 1918

Subject S. B. G., after being chilled as subject for fourteen experiments over a period of twenty-two days in midsummer, developed severe rhinitis, followed quickly by pharyngitis, ton-

sillitis, and injection of uvula and soft palate. Subject retained an abnormal susceptibility to colds throughout fall and early winter.

Subject S. M., after being chilled as subject for fifteen experiments over a period of twenty-four days in midsummer, developed a slight neuralgia in left shoulder. Next day was again subject. The day thereafter pleurisy developed in left chest. Neuralgia yielded to local treatment. Pleuritic symptoms lasted two weeks. Mucous membranes remained normal.

Chilled again in November without ill effect. Chilled December 4; experiment 4:00 to 6:00 p. m. By following morning slight congestion in nasopharynx had developed, which persisted three or four days. Chilled January 2 without after-effect other than nausea, vomiting and headache.

This subject noticed that entering the cold room from the hot outside air of summer was frequently followed by violent intestinal peristalsis and defecation. This subject irrigated his nose and throat after each exposure with a weakly alkaline salt solution, used hot, with the idea both of cleansing and of producing hyperemia. Following irrigation a spray of 0.5 per cent phenol in liquid albolene was used after the winter exposures.

Subject A. G., on August 1, chilled. After exposure, low grade pharyngitis developed and persisted some days.

Subject J. D. R., with chronic pharyngitis; chilled twice; subject thought after second exposure was exacerbation of pharyngitis.

Subject G. A. suffered after single exposure no ill effects other than headache.

Subject B. J. F., no symptoms after an observation experiment.

CONCURRENT BACTERIOLOGIC STUDIES—SUMMER OF 1919.

Several instances during the experiments of 1918 seemed at least suggestive of experimental excitation of infection. The case of S. M. in particular seemed to point to chilling as the exciting factor. The experiment was a blood temperature control in which he sat from 4 to 6:09 p. m., December 4, 1918, with closed mouth, the bulb of a thermometer beneath his tongue. He forced respiration from 4:12 to 6:09 p. m.,

and was chilled by a fan from 4:47 to 5:09 p. m. Shivering began at 4:48 p. m., and had become very severe by 4:52 p. m. The subject had not been aware of other recent exposure to cold or infection. By the morning of December 5, nasopharyngeal stuffiness had developed sufficiently to cause the remark by a friend that he had a cold. The symptoms persisted three or four days.

Similarly we have noted what we believe to be an excitation of infection after, and presumably due to chilling in a number of carefully observed instances in our everyday experience.

A study of the flora of the nose and throat during the experiments of the summer of 1919 seemed, then, to be well worth while.

Material and Method—The medium employed was a 5 per cent rabbit blood meat infusion agar. Baked blood agar was also used in each instance as a special medium for bacillus influenzæ. Sputum from each subject was injected into a mouse for typing pneumococcus. Cultures were taken from the nose through the anterior nares, from the tonsil, and from the posterior pharyngeal wall by means of separate swabs. Each swab was immersed in sterile broth and then applied both to a red and baked blood agar plate; the remaining area of the plate was inoculated by means of a platinum loop. Films were made directly from the same swab.

The cultures were incubated for 36 hours. The plates were then divided into eight segments, and every colony in two to four segments of the plate was counted and its nature determined. An attempt was made to detect any marked changes in the flora and particularly in the relative proportions of the bacteria present. On account of the difficulty of differentiating pneumococcus from streptococcus viridans by morphology these two were put in the same group.

Results.—Four different subjects were used in this study. Two developed clinical sore throats; a third had some symptoms of malaise and headache; a fourth was unaffected. The results obtained with the nose cultures were entirely negative. Subjects A. G. and S. M. showed staphylococcus aureus; subjects W. G. E. and S. B. G., staphylococcus albus. No attempt was made to sterilize the vestibule of the nose before swabbing. The flora obtained from the nose, as has been found

by other investigators (Thomson, 1913) was at all times exceedingly sparse, but the above organisms were always found to be present. They showed no changes with exposure. The results obtained from pharynx and tonsil in each instance are given in Tables 1 to 3.

From the pharynx and tonsil of Subject S. M. before the experiment there were cultured streptococcus viridans, pneumococcus, Type 11, atypical, and Bacillus influenzæ. He was then subject of Experiment 7. Within 24 hours he had a clinical sore throat; coincident with this, there was a sudden appearance of streptococcus hemolyticus in the cultures from both tonsil and pharynx. During the days following, with the disappearance of the sore throat, the number of colonies of streptococcus hemolyticus fell off rapidly. The remaining bacteria showed no evident change.

TABLE I.

Subject P. M. Bacteriology of Tonsil and Pharynx.

Date.	Place cultured.	*S. viridans* and Pn. H.		*S. haemolyticus.*		*B. influenzae.*		Undetermined.		Remarks.
		No. of colonies counted	Per cent of all colonies	No. of colonies counted	Per cent of all colonies	No. of colonies counted.	Per cent of all colonies	No. of colonies counted.	Per cent of all colonies	
1919										
June 4	Left tonsil.	28	93	0	0	2	7	0	0	
						0	0	0	0	
	Pharynx.	36	100	0	0	Present in baked blood.				
						" " " "		0	0	
						" " " "		4	6	
" 5	Left tonsil.	43	100	0	0					
	Pharynx.	31	94	0	0	" " " "		0	0	
						" " " "		4	14	
" 6	Left tonsil.	35	100	0	0					
	Pharynx.	24	86	0	0	3	6	0	0	Subject of experiment. Application on left tonsil. Cultures after experiment.
						4	13	0	0	
" 7*	Left tonsil.	52	94	0	0					
	Pharynx.	40	87	0	0					
						7	8	11	12	Subjective sore throat. Pharynx shows injection with white exudate; tonsillar ring injected.
						6	13	0	0	
" 8	Left tonsil.	57	65	13	15					
	Pharynx.	26	56	14	31					
" 9	Left tonsil.	35	76	6	13	1	2	4	8	Very slight soreness. Throat no longer injected.
	Pharynx.	34	79	9	21	Present in baked blood.		0	0	
" 11	Left tonsil.	34	94	1	3	1	3	0	0	Throat normal.
	Pharynx.	30	91	3	9	Present in baked blood.		0	0	

* Experiment 7.

TABLE II.

Subject W. G. E. Bacteriology of Tonsil and Pharynx.

Date.	Place cultured.	*S. viridans.*		*S. haemolyticus.*		*B. influenzae.*		*S. albus.*		Remarks.
		No. of colonies counted	Per cent of all colonies	No. of colonies counted	Per cent of all colonies	No. of colonies counted	Per cent of all counted.	No. of colonies counted.	Per cent of all colonies	
1919										
June 10	Left tonsil	18	42	4	9	9	21	12	28	
	Pharynx	13	52	0	0	12	48	0	0	
" 11*	Left tonsil	28	68	3	8	8	20	2	4	Subject of experiment. Application on left tonsil. Cultures after experiment.
	Pharynx	24	72	0	0	6	18	3	9	
" 12	Left tonsil	31	55	3	5	5	9	17	31	No after effects.
	Pharynx	18	54	0	0	12	36	4	9	
" 16†	Left tonsil	26	53	0	0	6	12	18	35	Subject of experiment. Application on soft palate. Cultures taken before experiment.
	Pharynx	32	60	0	0	9	17	12	23	
" 17	Left tonsil	14	45	2	7	8	26	7	22	Subject complains of general malaise; slight headache; no sore throat. Film from swab shows mostly Gram-negative bacilli with a few cocci.
	Pharynx									
	Red blood	0	0	0	0		100	0	0	
	Baked blood	0	0	0	0		100	0	0	
" 19	Left tonsil	19	56	2	6	5	15	8	24	
	Pharynx	21	60	0	0	14	40	0	0	
" 20	Left tonsil	21	50	3	7	7	17	11	26	
	Pharynx	19	58	0	0	11	33	3	9	

* Experiment B.
† Experiment 8.

TABLE III.

Subject A. G. Bacteriology of Tonsil and Pharynx.

Date.	Place cultured.	*S. viridans.*		*M. catarrhalis.*		*S. aureus.*		*S. albus.*		Remarks.
		No. of colonies counted	Per cent of all colonies	No. of colonies counted	Per cent of all colonies	No. of colonies counted	Per cent of all colonies	No. of colonies counted	Per cent of all colonies	
1919 June 7	Left tonsil	29	85	0	0	0	0	5	15	
	Pharynx	21	91	0	0	0	0	2	9	
" 8*	Left tonsil	49	90	0	0	0	0	5	10	Subject of experiment. Application on left tonsil. Cultures after experiment.
	Pharynx	27	75	0	0	2	6	7	19	
" 9	Left tonsil	21	60	3	9	0	0	11	31	No symptoms.
	Pharynx	31	57	15	27	1	2	7	14	
" 10†	Left tonsil	27	52	4	8	2	4	19	36	Subject of experiment. Application on right tonsil. Cultures after experiment.
	Pharynx	34	81	0	0	3	7	5	12	
" 11	Left tonsil	34	85	1	2	0	0	5	13	
	Pharynx	39	93	0	0	0	0	3	7	
" 12	Right tonsil	30	73	0	0	4	10	7	17	
	Pharynx	34	87	2	5	1	3	2	5	
" 13‡	Right tonsil	40	88	2	5	0	0	3	7	Subject of experiment. Application on pharynx. Cultures after experiment.
	Pharynx	27	70	7	19	0	0	4	11	
" 14	Right tonsil	21	58	12	34	0	0	3	8	
	Pharynx	15	45	4	11	11	39	2	5	
" 15										No cultures. Subject has soreness on swallowing.

June 16§	Right tonsil	21	52	11	27	0	0	8	20	Subject of experiment. Application on pharynx. Marked congestion of tonsillar ring and pharynx.
	Pharynx	29	60	15	31	0	0	4	9	
" 17	Right tonsil	34	72	3	7	8	17	2	4	Throat injection milder. No soreness on swallowing.
	Pharynx	27	75	6	16	3	8	0	0	
" 18‖	Right tonsil	25	59	2	5	15	36	0	0	Subject of experiment. Application on soft palate. Cultures after experiment.
	Pharynx	31	77	4	10	5	13	0	0	
" 19	Right tonsil	28	54	15	28	9	18	0	0	Soreness on swallowing. Injection of tonsillar ring.
	Pharynx	32	64	11	22	7	14	0	0	
" 20										No cultures. Sore throat disappeared.
" 21	Right tonsil	35	83	0	0	4	10	3	7	No soreness. No injection.
	Pharynx	31	93	1	3	0	0	1	3	
" 23	Right tonsil	31	81	2	5	1	2	4	11	No soreness. No injection.
	Pharynx	27	81	1	3	2	6	3	9	

* Experiment 9.
† Experiment 6.
‡ Experiment 10.
§ Experiment 11.
‖ Experiment 12.

Experiment 7.—Subject S. M., June 7, 1919, 3:45 to 6 p. m. Mucous membrane thermopile on left tonsil. Respirations, 14 per minute. Mouth open; nostrils plugged. Room temperature, 18.10—19.60° C., 0:00 to 0:31.5. Wrapped; normal breathing; swallowed many times. 0:31.5 to 0:44. Wrapped; deep breathing. 0:44 to 0:55.5. Unwrapped; fan on back; deep breathing. 0:53. Shivers. 0:55.5. Coughs, chokes, applicator removed; blood flecks seen about terminals. 4:57 p. m., experiment started again. 0:00 to 0:06. Wrapped; deep breathing. 0:06 to 0:13.5. Unwrapped; fan on; deep breathing; shivering; swallows many times. 0:13.5 to 0:33.5. Wrapped; deep breathing. 0:33.5. Conditions the same; amyl nitrite inhaled. 0:35 to 0:44. Wrapped; deep breathing, some coughing and swallowing. 0:44 to 0:53. Hot water bag around subject; wrapped; deep breathing.

On the following morning the feeling of soreness had practically left the traumatized tonsil, but the posterior wall of the oropharynx felt sore. On inspection a localized area of injection bearing a whitish exudate was seen on the posterior wall of the oropharynx. In culturing, the contact of the swab on this area was a little painful, and the culture yielded streptococci, as explained above. The tonsillar ring was injected, but the feeling of soreness on the tonsil entirely passed off during the day and contact of the swab in culturing was hardly felt. Thus the traumatized tonsil showed less evidence of being the site of an active infection than the posterior pharyngeal wall, which was thought not to have been directly traumatized, but of course we cannot exclude the possibility that the oropharynx was infected by hemolytic streptococci from the tonsillar crypts—so commonly a habitat for them—which were missed in the earlier cultures and were disseminated by the experimental trauma and swallowing.

In subject W. G. E., there were present streptococcus viridans, bacillus influenzæ, streptococcus hemolyticus, and staphylococcus albus. Following Experiment D there were no noteworthy changes. The plate inoculated from the pharynx about 26 hours after Experiment 8, however, showed a pure culture of bacillus influenzæ; the tonsillar plate showed also a slight relative increase. The film from the pharynx showed practically all Gram negative bacilli with an occasional coc-

cus. The subject had no sore throat, but complained of general malaise, slight headache, and some chilly sensations. (Compare the effect of infecting monkeys with bacillus influenzæ (Blake and Cecil, 1920).)

The pharynx culture made 96 hours after Experiment 8 was practically the same as before the experiment, streptococcus viridans and staphylococcus albus appearing as before.

Experiment 8 (for Experiment D, see page — above).—Subject W. G. E., June 16, 1919, 3:20 to 4:07 p. m. Mucous membrane thermopile on anterior half of soft palate, left side. Respirations, 16 per minute. Mouth open; nostrils plugged. Room temperature, 20.22—20.90° C. 0:00 to 0:05.5. Wrapped; normal breathing. 0:05.5 to 0:11. Wrapped; deep breathing. 0:11 to 0:32. Unwrapped; fan on back; deep breathing. 0:32 to 0:47. Wrapped; deep breathing.

With the applicator resting against the anterior soft palate there is no reason for supposing trauma to the tonsils and pharynx. Organisms could hardly have been introduced from outside by the applicator, for this, with the thermopile terminals attached, was freshly coated with shellac in alcoholic solution before being adjusted for an experiment.

Subject A. G. was the subject of five experiments, June 8, 10, 13, 16 and 18. On June 15 he noted a soreness on swallowing, and on June 16 the entire posterior pharynx and tonsillar ring were distinctly injected. The experiment of June 16 produced no sudden increase in symptoms; on June 17 the sore throat had practically disappeared. On June 19, 36 hours following an experiment, the subject again developed a soreness on swallowing, with congestion of the posterior pharynx and tonsillar ring. On June 20 the symptoms had subsided. On June 21 there was no longer any injection or soreness.

This subject had present in his throat streptococcus viridans, staphylococcus aureus, and staphylococcus albus. Twenty-four hours following the first experiment there was noted for the first time the appearance of micrococcus catarrhalis. Subsequently there appeared to be a certain degree of correlation between the appearances of sore throat and the rises in relative numbers of micrococcus catarrhalis colonies. No other change in the bacterial flora was apparent.

Experiment 9.—Subject A. G. June 8, 1919, 3:38 to 5:06 p. m. Mucous membrane applicator on left tonsil. Respirations, 10 per minute. Mouth open; nostrils plugged. Room temperature, 18.1—19.45° C. 0:00 to 0:06. Wrapped; normal breathing. 0:06 to 0:15. Wrapped; deep breathing. 0:15 to 0:43. Unwrapped; fan on back; deep breathing; some swallowing, coughing, and clearing of throat; after 0:17, shivering. 0:43 to 1:20. Wrapped; deep respiration. 1:07. Inhales amyl nitrite. 1:20 to 1:28. Hot water pad to back; deep respiration.

The possibility that trauma to the tonsil was responsible for the appearance of micrococcus catarrhalis after this experiment cannot be excluded.

Experiment 6.—Subject A. G. June 10, 1919, 11:30 a. m. to 12:17 p. m. Mucous membrane thermopile on right tonsil. Skin thermopile on forehead. Respirations, 16 per minute. Mouth open; nostrils plugged. Room temperature, 16.9° —17.8° C. 0:00 to 0:06.5. Wrapped, normal breathing. 0:06.5 to 0:18.5. Wrapped, deep breathing. 0:18.5 to 0:32. Unwrapped; fan on back; deep breathing; after 0:23.5 shivering. 0:32 to 0:47. Wrapped; deep breathing; contraction of pharyngeal muscles.

Experiment 10.—Subject A. G. June 13, 1919, 3 to 3:46 p. m. Mucous membrane applicator on posterior wall of oropharynx. Respirations, 16 per minute. Mouth open; nostrils plugged. Room temperature, 18.45—19.05° C. 0:00 to 0:04.5. Wrapped; normal breathing. 0:04.5 to 0:15. Wrapped; deep breathing. 0:15 to 0:26. Unwrapped; fan on back; deep breathing; coughed; cleared throat; contraction of pharyngeal muscles; after 0:22, shivers. 0:26 to 0:46. Wrapped; deep breathing; coughed and cleared throat several times; pharynx appeared normal.

Experiment 11.—Subject A. G. June 16, 1919, 10:30 to 11:30 a. m. Mucous membrane applicator on posterior pharyngeal wall. Respirations, 14 per minute. Mouth open; nostrils plugged. Room temperature, 18.90—19.80° C. 0:00 to 0:04.5. Wrapped; normal breathing; contractions of pharyngeal muscles. 0:04.5 to 0:23.5. Wrapped; deep breathing. 0:23.5 to 0:32. Unwrapped; fan on back; deep breathing.

0:32 to 1:00. Wrapped; deep breathing; contractions of pharyngeal muscles.

Experiment 12.—Subject A. G. June 18, 1919, 10:20 to 11:12 a. m. Mucous membrane applicator on soft palate, middle part. Respirations, 14 per minute. Mouth open; nostrils plugged. Room temperature, 18.75—19.55° C. 0:00 to 0:05.5. Wrapped; normal breathing. 0:05.5 to 0:15.5. Wrapped; deep breathing. 0:15.5 to 0:27. Unwrapped; fan on back; deep breathing. 0:27 to 0:52. Wrapped; deep breathing.

In subject S. B. G., there were present in the throat streptococcus viridans, pneumococcus type IV, and staphylococcus albus. Cultures were made daily from June 4 to 19; he was the subject of an experiment on June 6, 9, 14, and 17. There was practically no change in the bacterial flora of this subject throughout the entire period studied. Neither did subjective or objective signs of sore throat or cold develop. Frequently the cultures from the pharynx were almost sterile, there being from three to ten colonies over the entire plate.

DISCUSSION OF BACTERIOLOGIC RESULTS.

Streptococcus viridans was found in all four of the individuals studied, bacillus influenzæ in two, pneumococcus in two, and micrococcus catarrhalis in one subject.

In subject S. M., the increased number of streptococcus hemolyticus was definitely synchronous with the presence of a sore throat. There appears to have been a correlation between the high micrococcus catarrhalis counts and the presence of sore throats in subject A. G. The pure culture of bacillus influenzæ in the pharynx of subject W. G. E. was not coincident with sore throat, but with malaise, slight chilliness and headache.

These results in no sense prove, however, that the sore throats were caused by the increased number of bacteria cultured from the mucous membranes, or that the apparent increase of microorganisms was caused by the ischemia of the mucous membranes incident upon chilling of the body surface. The method is subject to so many sources of error, and the amount of data thus far obtained is so small that we do not feel justified in drawing any conclusions. To attribute the apparent proliferation of pathogenic microorganisms to the

effect of chilling would seem to be in harmony with the great wealth of clinical and common observation which points to excessive chilling, under proper circumstances, as an efficient excitant of infection of the mucous membranes by their indigenous pathogenic bacteria. Although it is possible that the apparent proliferation was due to the local ischemia incident upon chilling, the inaccuracy of the bacteriologic method and the insufficient data make it impossible to assume that this is so. The effect of trauma by the thermopiles, the possibility of transient changes in the flora of the mucous membranes caused by swallowing, gagging, or other muscular activity in the pharynx pressing a plug of bacteria from the tonsillar crypts, the fact that the subject's mouth was held open throughout the experiments, with the accompanying accumulation of mucus on the membranes, the errors necessarily introduced in each stage of making the cultures, and the inaccuracy of any method depending upon swab cultures, all tend to confuse the results. We present the data given above as a contribution to the etiology of upper respiratory infections, and not with the idea that the study is in any sense complete in itself.

CONCURRENT BACTERIOLOGIC STUDIES—SUMMER OF 1920.*

The bacteriologic methods of 1920 were essentially those of 1919, save that the baked blood plates for bacillus influenzæ were omitted and that the vestibule of the nose was in each case washed out before the nasal culture with cotton wet with tap water.

Results: Four subjects were used in this study. Cultures were made daily (with a few omissions) from June 21 to July 19, from the right and left nasal cavities, the right faucial tonsil and the posterior pharyngeal wall of two subjects, S. M. and A. G. The third, S. B. G., was similarly cultured from June 21 to June 30. The fourth, F. J. C., was cultured only once. S. M., A. G., and F. J. C. each developed a mild coryza. S. B. G. was unaffected.

Subject S. M. showed in the nose from the outset staphylococcus albus. On June 24 and thereafter staphylococcus aureus also was found. Diphtheroids appeared in cultures from each

*For detailed account see Goldman, Mudd and Grant (1921).

nasal cavity made four hours after his third intranasal experiment. Streptococcus albus remained throughout all the experiments. Streptococcus aureus was present occasionally, but, except on the days following its first appearance, in smaller numbers than streptococcus albus. The diphtheroids fluctuated in numbers and were sometimes absent. There was no apparent relation between their numbers and the chilling.

The tonsil contained at the outset nonhemolytic streptococci, pneumococci, and S. albus. Streptococcus hemolyticus appeared in the tonsil culture taken 24 hours after the first experiment on June 22; the applicator in this experiment was on the nasal septum and the subject's mouth was closed. Forty-eight hours after the experiment, a pure culture of S. hemolyticus appeared in the tonsil culture. The number diminished on the following day to 11 per cent of all colonies, and subsequently remained present in numbers from 1 to 12 per cent of all colonies counted, through July 12. Nose and throat remained clinically normal throughout this time. Further experiments were performed upon this subject July 12, 15 and 17, with the thermopile tips respectively on the nasopharyngeal and oropharyngeal wall and in the air of the postnasal space. The proportion of hemolytic streptococci in the tonsil cultures slowly rose during this time—July 12, 12 per cent; July 14, 16 per cent; July 16 and 17, numerous, not counted; July 19, 25 per cent; July 20, 36 per cent. July 17, this subject began to develop symptoms of coryza. By July 19 he had cough, nasal stuffiness and rhinorrhea and malaise. Symptoms present but abated the following day. This subject's mother had had a severe cold from about July 12; his symptoms may or may not have been connected with the experiments.

The pharynx showed nonhemolytic streptococci and pneumococcus and occasionally S. albus and S. aureus. June 27, S. hemolyticus appeared, and subsequently it was obtained in four cultures, each time associated with tonsil cultures containing a like organism. S. hemolyticus is so usual an inhabitant of the tonsils (Davis, 1920) that its incidence here may or may not have been connected with the experiments.

Subject A. G. showed in the nasal cavity initially S. aureus; subsequently S. albus appeared on each side. The right side showed usually a preponderance of S. albus, the left of S.

aureus. No other organisms appeared in the nasal cultures.

The right tonsil showed nonhemolytic streptococci throughout, i. e., from June 21 to July 19. A. G. was subject of an experiment June 21, 23 and 24; application was made on the anterior end of the right nasal septum, the anterior end of the left lower turbinate and in the left middle meatus, respectively. The symptoms of a slight rhinitis—nasal stuffiness, slight headache and slight mucopurulent discharge—developed June 24. The secretion and stuffiness persisted until June 29. June 24 two colonies of M. catarrhalis appeared on the tonsil plate, and June 26 one on the tonsil and three on the pharynx plate. June 28, S. albus began to be present in the right nostril. Otherwise no change in bacteriology was noted, the nose showing S. aureus and the tonsil and pharynx nonhemolytic streptococci as before. A. G. was again subject July 7 and 17, with the applicator on the right middle turbinate in the first case and with no mucous membrane application at all in the second. July 17, twenty colonies (44 per cent) of M. catarrhalis appeared on the tonsil plate. There were no accompanying clinical symptoms. Streptococcus hemolyticus appeared after the experiment of July 7, four colonies on the tonsil and one on the pharynx plate July 7, one on the tonsil plate July 8 and one on the tonsil plate July 12. These were the only appearances of hemolytic streptococci in this subject, either in the series of 1919 or 1920.

In Subject S. B. G. there were present in the nose S. aureus and S. albus. On the right tonsil there were S. nonhemolyticus, pneumococcus, S. aureus and S. albus. The pharynx showed S. nonhemolyticus and pneumococcus. There was practically no change in the bacterial flora throughout the period studied nor were there any signs of a cold. The cultures from the pharynx were frequently sterile and always showed relatively few bacteria, as was the case in this subject in 1919.

F. J. C., whose pharyngeal culture showed abundant hemolytic streptococci, developed a mild cold the day following his first experiment (applicator on left nasal septum). Unfortunately, a contagious origin cannot be ruled out, however, for his baby brother developed a cold about the same time.

Discussion: Nonhemolytic streptococci were found in all four individuals studied, pneumococci in two, S. hemo-

lyticus in three, and M. catarrhalis in one. In S. M., on one occasion there was an abundance of S. hemolyticus in the tonsil cultures before and during the symptoms of cold and sore throat. In F. J. C. a cold followed a single exposure of an individual with abundant hemolytic streptococci in his postpharynx. The appearance of M. catarrhalis in A. G. after experimentation was paralleled by a like occurrence in 1919.

INTERPRETATION OF REACTIONS TO CHILLING.

It is a fact beyond question that potentially pathogenic bacteria may lead a saprophytic existence upon the pharyngeal and tonsillar mucous membranes of healthy subjects (e. g., see Davis, 1920). It is equally indisputable that those bacteria may under appropriate circumstances become the active agents of infection, local or generalized. We believe that exposure to cold may be one such exciting factor of infection. We have shown also that chilling of the body surface causes a reflex vasoconstriction and ischemia in the mucous membranes of the nasal cavity, postnasal space, oropharynx, palate and tonsils. That the latter is the mechanism by which local resistance is lowered and infection excited we have not proved. However, there would seem to be justification for advancing, tentatively at least, the hypothesis that the ischemia may mediate the infection. Jonathan Wright in the course of a discussion of the etiology of acute upper respiratory infection (1914), page 295), says:

"It may well be, as has been admitted, that certain bacteria are at once pathogenic when they reach the mucous membrane. Indeed, this seems very probable when they reach the mucous membranes of certain individuals. It may well be that such individuals always present, owing to systemic states, conditions of the mucosa which offer an ever open avenue to infection; but granting all this, which indeed is in reality a part of our conception of the mechanism of the process, it seems extremely likely that local biochemical change, dependent upon molecular activities acting through the sympathetic nervous system, is the antecedent in the majority of cases of bacterial infection. This molecular disturbance of the normal activities of the sympathetic nerves may be set up by external or internal agencies, by the chilling of the body surfaces, or by derangements in the activities of the internal organs. Owing to the

fact that wet feet and the chilling of distant regions of the surface of the body are, at least in clinical experience, quite as frequently followed by coryzas and sore throats as the direct impact of such external influences upon the head and neck, we have the right to infer that the shock at the surface must be transferred to internal nerve ganglia and there translated into impulses which are carried to the surfaces of the mucosa of the upper air passages. There they give rise to the chain of biophysical and biochemical changes which may simply result in a mild coryza or a catarrhal pharyngitis, the resolution of which terminates the chain, or these conditions may be in themselves the starting point of bacterial invasion."

In the insufficient light of present knowledge, it would seem not improbable that the ischemia incident on cutaneous chilling, by decreasing cell respiration, or by retarding removal of the products of cell metabolism, or by increasing the permeability of the epithelial cell surfaces to the bacterial products, or by decreasing the local supply of specific antibodies, or by altering the media in the tonsillar crypts and folds of the pharyngeal mucosa in which the bacteria are living, or, especially when accompanied by direct chilling of the mucous membrane, by altering the state of aggregation of the colloids of the protoplasm (Schade, 1920), or by a combination of these factors, might effect the local change postulated by Wright and thus so disturb the equilibrium between host and parasite as to excite infection. We here use the term "infection" as denoting a process separable from that of invasion or penetration of the bacteria into or through the mucosa. For study of tonsils in the early stages of infection has usually shown the crypts swarming with bacteria with none demonstrable beneath the mucosa surface (Wright and Smith, 1914, p. 291; Wright, 1907; Goodale, 1899). There is much collateral evidence to support the hypothesis of Wright that a factor other than any of those suggested above—namely, the surface-tension relations of bacteria and mucosa cell surfaces (1909), enters into the determination of penetration or nonpenetration of bacteria through the mucosa. This hypothesis certainly deserves experimental investigation.

The demonstration that cutaneous chilling causes reflex vasoconstriction and ischemia in the nasal cavity, nasopharynx,

oropharynx, tonsils and palate at least furnishes a new and correct point of departure for future investigation, to replace the former false assumption of congestion.

That the mechanism we have elucidated is the only one concerned in exciting the acute cold it would be obvious folly to believe. The conditions determining the equilibrium between host and parasite in the tonsillar crypts and folds of the pharyngeal mucosa must be so extremely complex that many different factors are capable of disturbing it, either in the direction of proliferation of the parasites and infection or of their annihilation.

A mechanism perhaps more often responsible than ours for the acute "cold" has been elucidated by Leonard Hill and F. F. Muecke (1913). These workers found that in hot, moist, crowded rooms, such as ill ventilated theaters or meeting halls, the mucous membranes over the turbinate bones and nasal septum swell, become turgid with blood and tissue lymph, and covered with a thick secretion. In such crowded places massive droplet infection is likely to occur. On going out into cold, moist, outer air, the blood vessels constrict and the nasal mucous membrane is chilled but remains swollen with tissue lymph. These authors believe—and certainly with apparent justification—that this latter condition of the nasal mucous membrane affords a suitable condition for bacterial proliferation. They find that the dangerous primary passive congestion is much less if the air in the room is kept circulating and is not overheated.

The monograph of Leonard Hill (1919) especially urges the importance in causing colds of contagion and of the unnatural conditions of indoor life, where bodily vigor is not maintained by adequate outdoor exercise, crowding favors massive infection from those already actively infected and from carriers, and overheating of the atmosphere at head level causes passive congestion of the nasal mucous membrane and predisposes to infection. In Hill's monograph is to be found detailed discussion also of the effects on the respiratory membrane of altered respiration and of changes in temperature of the inspired air, as distinguished from the phenomena we have been especially studying, namely, the reflex effects on the mucous membrane circulation of chilling the body surface without

altering the quality of the inspired air. The effect of physical exertion (without excessive fatigue, of course) in increasing respiration and hence transudation of liquid through the respiratory membrane, is emphasized by Hill as a valuable factor in the prevention of initiation of infection of the respiratory membrane.

It should be clearly borne in mind that the factors of contagion and of general bodily health are probably of considerably greater importance to preventive medicine and the welfare of the community than the effects of chilling of the body surface.

We would reiterate also in order to minimize any possibility of misunderstanding. We are concerned in our experiments with excessive chilling of the body surface, which, like overdosage of a useful drug, we believe may have ill effects. Certainly we would not encourage the unreasoning fear of drafts and exposure so often encountered. Good ventilation and circulating air in buildings, cold weather, and out-of-door living are needed for vigorous health; many people are unquestionably benefited by cold bathing. Bnt excesses in this direction should also be avoided.

Individual differences in susceptibility should also be borne in mind. (See Sticker, 1916.) Thin, anemic and delicate persons can in general stand less exposure than stocky, "full-blooded" ones. There is evidence also that peculiar susceptibility to catching cold may exist as an individual idiosyncrasy.

We are now in a position to outline an explanation for the annual cold weather increase in incidence of upper respiratory diseases, which, although admittedly incomplete and in part speculative, would yet seem to fit well the known facts. With the beginning of cold weather, cessation of summer and autumnal out-of-door life, and beginning of hot air and steam heating, conditions of living for the average American and European become less favorable to general health and resistance. Opportunity for excitation of autoinfection by prolonged or excessive chilling become more frequent, as do those for cross-infection in crowded cars and meeting places, w[illegible]
cous membranes are rendered more susceptible to infection by the close, hot atmosphere (Hill and Muecke, 1913). As the bacteria gain foothold and multiply on one after another

susceptible mucous membrane it is in harmony with known immunologic facts to suppose that they tend to increase in virulence and so add another factor to the general tendency to increased prevalence of respiratory infection. With moderation of the weather and return to out-of-door life in the spring, aided possibly by some as yet unknown cyclic or other change in the bacterial invaders (Journ. Am. Med. Assn., 1920, LXXV, 1500), we would expect the annual decline in prevalence.

How practically to escape respiratory infection in so far as possible? Lead a vigorous and healthful life with adequate sleep, food, exercise and fresh air. Bathe daily. Keep the houses sufficiently warm to be comfortable, but not, as most American houses are in winter, overhot and overdry. Avoid contagion from infected persons, remembering that respiratory diseases are communicated chiefly through droplets of mucous sprayed into the air through coughing, sneezing or speaking. Avoid excessive irritation of the mucous membranes by tobacco of the body surface. Avoid crowding in hot atmospheres. Obstructions to breathing or foci of infection, if present, should of course be removed. Some degree of "hardening" to exposure, graded and adapted to the needs of the individual, we believe is possible, and of the greatest service. As one valuable factor in this process, one of us at least, after some eight years' trial, is convinced of the efficacy in his own case of a daily morning shower bath with warm water, concluded with a few minutes of very cold water.

IV.—ANAPHYLACTIC "COLDS."

The discussions of vasomotor rhinitis and of asthma in the majority of the current texts will have to be entirely rewritten. The rescue of these affections from the nebulous province of diatheses and neuroses, their establishment upon a definite and sound, if not wholly complete, etiologic and therapeutic basis, makes up one of the chapters of modern experimental medicine upon which one's imagination lingers with most satisfaction. Since, however, thoroughly modern and adequate treatments of this subject are available (v. Goodale, 1918, and Walker, 1919), they will not be further discussed here beyond pointing out a subgroup of cases recently come within the

experience of workers in the field, which simulate recurrent common acute colds.

I cannot do better than quote briefly from Dr. Walker (1919, p. 146):

"It is not at all uncommon for some patients to complain of what they call hay fever symptoms or very frequent head colds throughout the year. Since this kind of case seeks aid from the nose specialist, who terms the condition vasomotor rhinitis, the internist sees little of the condition, and even when the internist does see the case first he immediately refers the case to the nose specialist. In the future, however, such cases should be tested for sensitization to proteins. Not infrequently are the emanations of animals the cause of these all the year hay fever symptoms. Horse hair dandruff and cat hair are frequently the cause of these spasmodic attacks of hay fever, which last a few minutes to a few hours or even a day or two, and in such instances the patient gives a positive skin test with the proteins of the hair. Less often the injection of various foods causes spasmodic attacks of short duration simulating hay fever. True seasonal pollen cases frequently complain of frequent head colds throughout the year, and these head colds closely simulate short attacks of hay fever. In some of these pollen cases the sensitization serves to permanently render the mucous membranes extremely sensitive and irritable, so that sudden temperature changes, drafts, odors and dust particles are sufficient to produce symptoms; in other pollen cases bacteria seem to be the cause." See also Goodale (1916), Floyd (1920), and Walker (1920). The important point here for the laryngologist, internist and pediatrist to remember is that frequently recurring "colds" may have protein sensitization as their basis and to be in readiness to do the skin tests when indicated.

V.—ACUTE INFLAMMATION DUE TO SYSTEMIC, TOXIC AND NEUROTIC FACTORS, TO MECHANICAL AND CHEMICAL IRRITATION, TO EXTREME LOW TEMPERATURE AND TO NASAL OBSTRUCTION.

A discussion of the etiology of acute inflammation of the nose, throat and tonsils should at least give passing mention

to various inflammatory conditions of the upper respiratory tract associated with more general affections. Acute rhinitis occurs as a local prodromal symptom of influenza, measles, scarlatina, whooping cough, enteric, typhus, smallpox, chickenpox, secondary or congenital syphilis and glanders. (Thomson, 1913, p. 113). Similarly for acute pharyngitis. Diphtheritic and gonorrheal rhinitis occur; also that of erysipelas.

Acute upper respiratory inflammations may be set up in those exposed to local irritants, as millers, furriers, sawyers, tobacco workers, ivory and steel turners, and decorators, or (Schade, 1920) when the mucous membranes are exposed to extreme low temperatures. Locally the vapors of formalin, the halogens, ammonia and the fuming mineral acids and dust and coal and tobacco smoke may give rise to them. A destructive form of rhinitis may occur in workers in bichromate of potash, mercury, arsenic or osmic acid. Acute pharyngitis not infrequently follows traumatism, as the swallowing of hot fluids, corrosives, hot condiments, raw spirits, and the impaction of foreign bodies. It may be induced by operations on the pharynx with much sponging or traction on the tissues, e. g., enucleation or morcellement of the tonsils. Secondary infection may of course aggravate any such primary condition.

Acute mucous membrane inflammation may occur in connection with the administration of certain drugs, as potassium iodid, arsenic, mercury and antimony.

Acute rhinitis "is predisposed to by all obstructive affections of the nose and postnasal space. Chronic hypertrophic rhinitis, deformities of the septum, polypi and chronic empyemata conduce to the contraction and exacerbation of acute nasal catarrh: and frequent and persistent rhinitis in children is generally due to nasopharyngeal adenoids. Indeed, a large majority of children who are reported to be always catching a 'cold in the head' will be found to possess inflamed or overgrown pharyngeal tonsils." (Thomson ibid.)

A vasomotor turgescence of the nasal mucous membrane may originate in certain individuals from some reflex, such as chilling of the feet, sudden exposure to bright light or damp air, inhalation of vitiated air, gastric disorder, or sexual irritation.

VI.—CONCLUSIONS.

The following causes of acute inflammation of the pharynx, tonsils and nose are recognized in the present dissertation:

1. The filterable virus of Kruse and Foster, inducing apparently a clinical entity, a type of acute coryza. According to the experiments of its discoverers, this is of relatively high virulence and may cause infection practically independently of the action of exciting factors.

2. Various bacteria, including the pneumococcus, streptococci, B. rhinitis, B. diphtheriæ, Friedländer's bacillus, B. influenzæ, and probably also M. catarrhalis, B. septus, M. paratetragenus, S. aureus, the meningococcus, Vincent's spirillum and fusiform bacillus, and possibly others, seem to be capable of inducing infection of variable extent, duration and symptomatology. The relative virulence of the microorganisms also varies within wide limits—both between themselves and from time to time in the same organism—in some instances high, infections of epidemic proportions, largely independent of exciting factors, may be produced; in other instances low, sporadic infection may occur only when some factor or factors serve to depress resistance, general or local, to the point of vulnerability.

3. Protein sensitization, the basis of vasomotor rhinitis and of true bronchial asthma, the underlying cause also of a relatively infrequent subgroup of acute recurrent "colds."

4. Various systemic diseases, drugs, mechanical, thermal and chemical trauma, chronic nasal affections and reflex neuroses.

One factor by which resistance to bacterial infection may be lowered is excessive chilling.

Experiments by many workers have shown that animals whose blood temperature is lowered may have decreased resistance to infection. This, however, we believe, is not the mechanism by which chilling excites the common upper respiratory infections in man.

Experiments have shown that chilling of the body surface of animals causes congestion of many internal organs. Reasoning from a faulty analogy, the theory has been evolved and made widely current that similar congestion occurs in the

upper respiratory mucous membranes of man when chilled and is responsible for the local lowering of resistance. However, the work of the present authors has shown that the opposite is true, namely, that chilling of the body surface causes reflex vasoconstriction and ischemia in the mucous membranes of the nasal cavity and postnasal space, palate, oropharynx, nasopharynx and palatine tonsils. It seems not improbable that the ischemia may be the means of lowering local resistance. In other instances the mechanism of Hill and Muecke, i. e., crowding in overheated places followed by emergence into a cold atmosphere, is doubtless responsible for colds.

During the course of the experiments by which the vasoconstrictor reaction to chilling has been demonstrated, some ten cases of cold or sore throat, usually mild, have appeared among the subjects. In a number of instances the clinical symptoms were accompanied by interesting bacterial changes.

It is a pleasure to thank the friends, without whose generous aid as subjects much of the present work would not have been possible.

A paper describing repetition, corroboration and extension of our studies upon the tonsils has come from Italy too late to be included above (Azzi, 1921). Azzi used also more circumscribed stimuli, such as a draft of cold air on one exposed foot or immersion of one of the subject's hands in cold water. Such local applications of cold elicited reflex vasoconstriction in the tonsillar mucous membrane just as more extensive chilling does, although quantitatively somewhat less. Warming the body surface generally or locally without previous chilling Azzi found to result in reflex vasodilation in the tonsils, just as with rewarming after chilling. When the subject was chilled subsequently to such heat application, however, the tonsil vessels usually remained dilated. During the experiments on himself Azzi fell sick with a febrile rheumatic affection and mild tonsillitis. His inflamed tonsils did not exhibit vasomotor response either to cutaneous chilling or warming.

Attention is also called to a late paper by E. O. Jordan and W. P. Sharp (1921), showing negative results in prophylactic vaccination against colds with W. H. Parks' Pfeiffer

bacillus-streptococcus-pneumococcus vaccine, despite belief of many of the inoculated to the contrary. "'Satisfied patient' conclusions differ widely from those of controlled statistics."

BIBLIOGRAPHY.

Abel, 1892: Centralblatt f. Bak., xii, 841.

Allen, 1906: Brit. Med. Journ., i, 1131.

Allen, 1913: Bacterial Diseases of Respiration and Vaccines in Their Treatment, London.

Ansiaux, 1889: Bull. de l'Academie Royale des Sciences, etc., de Belgique, xvii, 581.

Azzi, 1921: La riforma med., xxxvii, 175.

Ballenger, 1908: Diseases of the Nose and Throat, 109, 132, 334.

Barker, 1916: Monographic Medicine, ii, 550.

Barnes, 1914: The Tonsils, 79.

Benedict, Miles and Johnson, 1919: Proc. Nat. Acad. Sci., v, 218.

Benham, 1906: Brit. Med. Jour., i, 1023.

Bezancon et de Jong, 1905; Bull. de la Soc. Méd. des Hôp. de Paris, xxii, 165.

Blake and Cecil, 1920: Jour. Am. Med. Assoc., lxxiv, 170; Jour. Exp. Med. xxxii, 691.

Cautley, 1894-5: Report of the Local Govt. Board, Great Britain, Supplement, p. 455.

Cecil and Steffen, 1921: Jour. Infect. Dis., xxviii, 201.

Coakley, 1914: Diseases of the Nose and Throat, 79, 287.

Cocks, 1915: Tr. Amer. Laryng. Rhin. and Otol. Soc., 138.

Coolidge, 1918: Diseases of the Nose and Throat, 95.

Davis, 1920: Journ. Am. Med. Assoc., lxxiv, 317.

Dunn and Gordon, 1905: Brit. Med. Jour., ii, 421.

Floyd, 1920: Boston Med. and Surg. Journ., clxxxii, 389.

Foord, 1918: Jour. Infect. Dis., xxiii, 159.

Foster, 1916: Jour. A. M. A., lxvi, 1180.

Foster, 1917: Jour. Infect. Diseases, xxi. 451.

Galeotti, 1920: Riforma Med., xxxvi, 205; abstracted in J. Am. Med. Assoc., 1920; lxxiv, 1491.

Galeotti, 1914: Archiv. f. d. ges. Physiol., clx, 27; Galeotti, Scaffidi and Barkan, Reports of the R. Accad. Dei Lincei, 1914, xxiii, serie 5a 2o sem. fasc. 7e, Rome.

Gohn u. Pfeiffer, H., 1902: Zeitschr. f. Klin. Med., xliv, 262.

Goldman, Mudd and Grant, 1921: Jour. Infect. Dis., to be published.

Goodale, 1899: Journ. Boston Soc. Med. Sciences, iii, 68.

Goodale, 1916: Annals of Otology, Rhinology and Laryngology, 25, 527.

Goodale, 1918: Boston Med. and Surg. Journ., clxxix, 293.

Gordon, quoted by Benham, loc. cit.

Grant, Mudd and Goldman, 1920: Journ. Exp. Med., xxxii, 87.

Grayson, 1902: Diseases of the Nose, Throat and Ear, 82, 231.

Hajek, 1888: Berlin, Klin. Wochenschr., 33, 659.

Hill, 1919: Gt. Britain Med. Research Com., Special Rep. Series Part 1, No. 32.

Hill and Muecke, 1913: Lancet, i, 1291.

Howell, 1915: Journ. Infect. Dis., xvi, 456.
Hüter, quoted by Benham, loc. cit.
Jordan and Sharp: 1921. J. Infect. Dis., xxviii, 367.
Kisskalt, 1901: Arch. f. Hygiene, xxxix, 165.
Kruse, 1914: Münch. Med. Wochenschr., lxi, 1547.
Kyle, 1914: Diseases of Nose and Throat, 73, 75, 422, 472, 521.
Lassar, 1880: Virchow's Archiv., lxxix, 168.
Liebermeister, 1860: Archiv. f. Anat., Physiol., u. Wissensch. Med., 523.
Lingelsheim, 1912: Kolle u. Wassermann's Handb. d. Pathogenen Mikroörgan, iv, 481.
Loewe and Zeman, 1921: Jour. Am. Med. Assoc., lxxvi, 986.
MacCallum, 1920: Textbook of Pathology, 386.
Marchand, 1908: Krehl u. Marchand's Handb. d. allgemeinen Path., i, 130.
Mathers, 1917: Journ. Inf. Dis., xxx, 1.
McLaughlin, 1920: Boston Med. and Surg. Jour., clxxxiii, 1.
Miller and Noble, 1916: Journ. Exp. Med., xxiv, 223.
Mudd and Grant, 1919: Journ. Med. Research, xl 53-101.
Mudd, Goldman and Grant, 1921: Jour. Exp. Med. xxxiv, July number.
Nägelsbach, 1920: Deut. Zeitschr. f. Chir., 1920, clx, 205.
Neufe'd u. Händel, 1912: Kolle u. Wassermann's Handb. d. Pathogen Mikroörgan., iv., 568.
Neumann, 1902: Zeitsch. f. Hygiene, xl, 33.
Olitsky and Gates, 1920: Jour. Am. Med. Assoc., lxxiv, 1497.
Olitsky and Gates, 1921: Jour. Exp. Med. xxxiii, 125, 361,373; Jour. Am. Med. Assoc., lxxvi, 640.
Packard, 1914: Osler and McRae's Modern Medicine, ii, 843.
Paulsen, 1890: Centra'bl. f. Bak. u. Parasit., viii, 344.
Pfeiffer, R., 1913: Cit. by Neisser in Kolle u. Wassermann's Handb. d. Pathogenen Mikroörgan, iii, 146.
Phillips, 1919: Diseases of Ear, Nose and Throat, 492.
Rosenau, 1920: Preventative Medicine and Hygiene, 195.
Rossbach u. Aschenbrandt: Cit. by Kisskalt, loc. cit.
Schade, 1919: München Med. Wochenschr., lxvi, 1021.
Schade, 1920: München Med. Wochenschr., lxvii, 449.
Schüller, 1881: Cit. by Winternitz, Die Hydrotherapie, 113.
Sticker, 1916: "Erkältungskrankheiten u. Kälteschäden in the Enzyklopädie d. Klin. Med., Berlin.
Thomson, 1913: Diseases of the Nose and Throat, 91.
Tilley, 1919: Diseases of the Nose and Throat, 26, 341.
Trommsdorf, 1906: Arch. f. Hygiene, lix, 1.
Tschalussow, 1913: Archiv. f. d. gesammte Physiol., cli, 541.
Tunnic'iff, 1913: Jour. Infect. Dis., xiii, 283.
Tunnicliff, 1915: Jour. Infect. Dis., xvi, 493.
Walker, 1919: Oxford Medicine, ii, Part 1, 115, 143.
Walker, 1920: Journ. Am. Med. Assoc., lxxv, 782.
Winternitz, 1881: Die Hydrotherapie, 113.
White, quoted by Benham, loc. cit.
Wright, 1907: New York Medical Journal, lxxxv, 437.
Wright, 1909: The Laryngoscope, xix, 321.
Wright and Smith, 1914: Diseases of the Nose and Throat, 295.

II.

THE BORDERLAND OF OTOLARYNGOLOGY AND OPHTHALMOLOGY.

By Hanau W. Loeb, M. D., and Meyer Wiener, M. D.,
St. Louis.

Our own experience and a careful survey of the literature have forced upon us the following conclusions which it is the purpose of this paper to elucidate and to defend:

1. Lesions of the eye and its adnexa occur far more frequently from pathologic processes involving the nose and paranasal sinuses than is generally accepted.

2. A study of the minor processes would result in a more fruitful yield than that which has followed the interest in the exceptional and striking cases manifest up to the present time.

3. It is necessary to examine and to study in detail the nose and para nasal sinuses in all eye conditions for which they may be responsible, including conjunctivitis, lacrimal sac conditions, orbital cellulitis and abscess, corneal ulceration, iritis and its associates, maturing cataract, retinal hemorrhage, retinal detachment, optic neuritis, ocular and retrobulbar, optic atrophy, glaucoma, reduction of vision, diminution of the field and functional disturbances not otherwise explained.

4. It is most important to examine for and to record any changes in the orbital or ocular tissues in all cases of acute or chronic suppurative processes involving the paranasal sinuses.

5. Persistent and intelligent study along these lines must bring about a solution of many of the vexing problems which have been uncovered by the casual study of the relation between the eye and the upper respiratory tract.

I.—THE ANATOMIC RELATIONS.

Grossly the eyes lie one on each side of the nasal cavities which, however, come into closer relation by the extension of the paranasal sinuses, below, behind, above and internal to the orbital cavity. In other words, the sinuses form a pneumatic boundary internally, superiorly and inferiorly, which,

however, continues subject to nasal influences by reason of the extension of the nasal mucosa throughout each sinus.

A clear view of the intimacy of this anatomic association is shown in the illustrations herewith presented. Fig. 1* shows the bone relations of the sinuses to the orbit, the thin bone of the orbital wall of the sinuses being removed. Fig. 2 shows the bone relations of the frontal sinus to the orbits. In Fig. 3 the bone has been cut away, leaving the mucosa intact, showing how extensive and intimate is its relation to the orbital contents. The frontal, ethmoid, sphenoid and maxillary sinuses are readily recognized. Figs. 4 and 5 show this relation in coronal section, the first at the opening of the maxillary sinus into the nose, the second just anterior to the sphenoid sinus.

Of the dissections of the optic nerve and paranasal sinuses made by Loeb, that shown in Fig. 6 is presented as exhibiting the course of the nerve along the sinuses whose mucosa has been left intact.

The mere propinquity of the eye to these sinuses with their extensive mucosal covering would speak for an association of pathologic conditions both frequent and important, even if specific details were not at hand. The extension of this mucosa by continuity to the conjunctiva through the lacrimal passages adds another concrete factor to this association.

Dehiscences in bone walls, as pointed out by Zuckerkandl, Onodi and others, bring the pathologic process closer to the seat of complications. This is still further manifest in the unusual relations sometimes present between the optic nerve and the sphenoid and the ethmoid, as shown by the same authors, and the fact brought out by Loeb, that sometimes the orifice of the sphenoid sinus lies at or above the level of the optic nerve and that, in two out of thirty instances of heads studied, the course of the nerve was along the outer wall of the posterior ethmoid cell which had replaced the sphenoid. Under usual circumstances, the nearest and only point of relation to the optic nerve is the superior posteroexternal angle

*This and the succeeding illustrations are reproduced by permission, from Loeb's "Operative Surgery of the Nose, Throat and Ear."

of the last posterior ethmoid cell. Compare Fig. 7 and Fig. 8.

But there are other relations quite as important if not as intimate from the standpoint of contiguity. This pertains more especially to the nerves and vessels.

The ophthalmic artery gives off the ethmoid arteries which supply the ethmoid cells and a large portion of the upper part of the nasal cavity. Still more important are the ethmoid veins which empty into superior and inferior ophthalmic veins.

In addition, the extensive anastomosis still further accentuates the vascular influence. Of the nasal and ocular lymphatics, little so far has been determined, but there is manifestly quite as intimate an association as exists in the vascular supply.

The nerve distribution is no less convincing. There are two factors in this connection. In the first place, two branches of the supraorbital supply a large portion of the nasal mucosa, the branches of the posterior ethmoidal being distributed to the sphenoid sinus and posterior ethmoidal cells, those of the anterior ethmoidal to the septum, roof, middle turbinate and anterior portion of the inferior turbinate. Anastomotic branches add to the connection between the oculoorbital and the nasal nerve supply.

In the second place, the nerve relations of the sphenoid sinus, as studied by Sluder, constitute the means by which ocular symptoms may follow disease of this sinus.

Of the anatomic relations of the ear and eye, there is little to be said. The sixth nerve, however, may become affected by pressure at the apex of the petrous pyramid through a localized leptomeningitis incident to an acute suppurative otitis media.

The pharynx and larynx have no close anatomic relations with the eye except perhaps through Meckel's ganglion, which sends branches to the pharynx as well as the eye and nose.

II.—PATHOGENESIS.

Autopsy evidence of the pathologic relation between the ear, nose and throat and the eye is unfortunately slight. Where autopsies have been performed the process was found so extensive that little could be ascertained as to the origin of the

trouble. Autopsies upon those dying of intercurrent disease in the presence of one of these conditions are rare, and when they have been performed little evidence has been uncovered.

However, we are not altogether without knowledge in this regard, as operative procedures have given some information, and inference and comparison with allied processes are of some value.

Except in malignant disease, tuberculosis, syphilis, etc., the nose, throat and ear are the original seat of the pathogenic process which brings them into relation with the eye. A malignant disease may extend from the orbit to the nose or vice versa. Tuberculosis, syphilis and diphtheria may appear either simultaneously in the eye and nose, or they may appear first in either organ.

So far little has been developed to show that any special bacterial invasion of the nose or accessory sinuses has any predilection for the eye, other than that acute virulent processes affecting the sinuses are more prone to result in orbital abscess. At any rate, with the possible exception of the work of Dewatripont upon the bacterial causes of disease of the nasolacrimal passageways, investigations have not been successful in differentiating the various types of bacteria with reference to their influence on any special oculoorbital disease of nasal and paranasal origin.

The means by which the disease process may extend from the nose, throat and ear to the eye may be summarized as follows:

1. By extension along the mucosa. This applies more especially to processes involving the nasolacrimal tract and the conjunctiva.

2. By pressure, as when the orbital wall is invaded by a mucocele or other process which bulges out the sinus wall.

3. By extension through dehiscences, mainly in the production of orbital cellulitis and abscess.

4. By destruction or necrosis of the boundary walls. Autopsies have shown that orbital abscess may originate in this way.

5. By periostitis of the sinus wall, by direct invasion or through the bone vascular system.

6. By the vascular and lymphatic systems. This group includes three divisions:

a. Cases of frank thrombophlebitis of the cavernous sinus, the ophthalmic vein and other vessels.

b. Those due to obstruction of the circulation, such as edema of the eyelids, chemosis, exophthalmus, etc. Conditions such as swelling of the papilla and optic neuritis associated with blindness almost miraculously and instantly relieved by intranasal operation are probably of vascular origin, comparable to edema glottidis occurring in connection with a severe infection of near-by tissues.

c. Those in which the vessels are merely the transmitting agent. The first two divisions of this interesting group of cases have been pathogenically faily well established. The third has the same basis as that which pertains to the origin of polyarthritis, endocarditis and nephritis from remote foci. Iritis comes under this class. For years it has been known that iritis is usually associated with syphilis or rheumatism, but only recently has the tonsil relation of polyarthritis been applied to iritis.

The lymphatic system has been included with the vascular system in spite of our lack of knoweldge of the lymphatics of the eye and nose, for the reason that the lymph flow is so closely associated with the vascular circulation and because of the behavior of lymphatic absorption elsewhere in the body.

7. By the nervous system. Of these we have two classes:

a. Cases due to pressure, extraneous or from inflammation within the nerve sheath and trophic disturbances. These include optic neuritis, with its sequelæ, optic atrophy, paralysis of the ocular muscles, blepharospasm, paralysis of accommodation. Paralysis of the abducens may result from a localized meningitis occurring in connection with a suppurative otitis media.

b. Cases in which the nervous relation is more or less indefinite or obscure. This has reference to those which for want of better pathogenic understanding are termed functional, reflex, etc. With the increase of our knowledge of pathology, this group is likely to shrink more and more by its replacement to other groups.

III.—THE NOSE, THROAT AND EAR RELATIONS.

The paranasal sinuses are the dominating influence in the more serious oculoorbital conditions of nasal origin, yet a deflected septum or a hypertrophied middle turbinate which obstructs any of the sinus orifices may be of etiologic significance. These conditions may be responsible for a number of minor affections such as conjunctivitis of various types, inflammatory and obstructive conditions of the lacrimal passageways, and slight deficiencies in vision. Dewatripont, who has made an extensive study of the diseases of the nasolacrimal passageways, agrees with the statement made by Kuhnt that 95 per cent of the cases have a nasal origin. Magitot studied 100 cases of keratoconjunctivitis in an ophthalmic center and found 95 per cent suffering from nasal lesions as follows:

1. Acute rhinitis, followed by coryza with or without hypertrophy, 30 per cent.

2. Atrophic rhinitis with or without ozena, 5 per cent.

3. Tertiary syphilis of the nose, 7 per cent.

4. Maxillary or frontal sinusitis, acute or chronic, 13 per cent.

5. Mucous polypi often compressing the nasolacrimal canal, 3 per cent.

6. Septum deviations with large spurs, comprising the inferior meatus, 25 per cent.

7. Stenosis of the inferior meatus by approximation of the inferior against the lateral wall of the nasal fossa, 15 per cent.

8. Cicatricial lesions of the inferior meatus resulting from resection of the anterior portion of the internal wall of the maxillary sinus in the course of a radical cure of the disease.

Most of the eye complications connected with the nose result from acute or chronic suppuration of the paranasal sinuses, but some of the more interesting ones may follow acute inflammatory processes with little or no pus. The more serious complications usually occur in connection with a closed empyema. And yet, there does not seem to be a clear line of demarcation between the effects of any of these lesions on the variety, severity or duration of the resulting complications.

While most of the sequelae may result from lesions of any

of the sinuses, each sinus seems to have a fairly well established adherence to certain of these complications.

They are as follows:

1. Ethmoid Cells: Swelling of the inner angle of the upper eyelid, orbital cellulitis and abscess, exophthalmus, diplopia, visual deficiencies, disease of the nasolacrimal passageways, iritis, vitreous opacities, papilledema, optic neuritis, optic atrophy.

2. Sphenoid Sinus: Thrombosis of the cavernous sinus, optic neuritis, optic atrophy, paralysis of the third, fourth and sixth nerves.

3. Frontal Sinus: Proptosis from mucocele and suppuration, orbital cellulitis and abscess, edema of the lids, diplopia, conjunctivitis, iritis, corneal ulceration, vitreous opacities, optic neuritis and atrophy.

4. Maxillary Sinus: Edema of the lower lid, conjunctivitis, orbital cellulitis and abscess, optic neuritis and atrophy.

The ear influence is limited practically to abducens paralysis. However, no account is here taken of the interesting oculovestibular manifestations of nystagmus and of the retinal changes in the intracranial sequelæ of otitis media suppurativa, which form no part of this paper.

The tonsils have been found the focus of origin in iritis, iridokeratitis and iridocyclitis, which have heretofore been known to be associated with rheumatism. It will not be strange if other inflammatory conditions about the eye are found to be due to tonsil infection or to toxic processes originating in the tonsil.

The relation of phlyctenular keratitis to adenoids seems to be generally accepted.

There are those who consider that the thickened patches in trachoma and in follicular pharyngitis bring them into association, but this is quite doubtful.

IV.—THE EYE RELATIONS.

The eye conditions due to nose and throat lesions reported in the literature are astonishingly large, both in number and variety, in spite of the fact that the reporters have heretofore been mainly interested in the unusual and startling types. An analysis of these cases shows that the nose and throat are com-

mon factors, even making allowance for the enthusiasm of the observers. We are convinced, however, that this enthusiasm is fully warranted by the facts.

The following summarizes our observations:

1. Pain. Generally speaking, the nose or the paranasal sinuses may be held accountable for pain in the eye or eyes, in the absence of any external ocular inflammatory signs, especially when it begins in the morning or upon awakening. The pain may be described as an eyeache, a pain between the eyes or in the temple. (Usually one side.) This pain almost always disappears after the patient has been up for a while, or at least it is greatly alleviated, in contradistinction with eye pain produced by eye strain or intraocular disease, which always increases towards evening. The pain is also relievable by cocain applications to the nasal mucosa. It is often accompanied by a general redness of the bulbar conjunctiva, epiphora and more or less photophobia and dizziness.

2. Epiphora, Dacryocystitis, Stenosis of Duct, Fistula, Etc.: These long recognized and familiar signs of a nasal lesion are most frequently associated with a common cold or coryza. They may, however, be caused by a mechanical obstruction in the nasal cavity; by extension of the infection directly into the nasal duct; by extension of the infection indirectly from an infected nose and by reflex irritation in the nose.

Mechanical obstruction of tears may be due to hyperplasia of the inferior turbinate or even the middle turbinate or of the mucosa immediately surrounding the valve of Hasner.

A case has been described by Wiener in which the cause was a membrane stretched across the nasal opening of the nasal duct, the mere splitting of which relieved the tearing.

Inflammation of the nasolacrimal passageways may result from ethmoid or frontal lesions by direct pressure or contact infection, and this may sometimes occur in maxillary suppuration. Elschnig attributes 50 per cent of the cases of dacryocystitis to an extension of an ethmoiditis.

3. Lids and Orbit. Redness of the lid margins, acute or chronic blepharitis marginalis, slight edema or puffiness of the lids, dark circles under the eyes are common sequelæ of nasal obstruction or of inflammation of the nose or paranasal sinuses.

Orbital cellulitis, phlegmon and abscess have long been understood to be generally of sinus origin. Even in children and infants this has been substantiated, although the small size and seemingly slight importance of the sinuses in children has been assumed sufficient to exclude them from consideration.

Birch-Hirschfeld cites statistics of 684 cases of orbital inflammation; he found 409, or 59.8 per cent, due to sinus infection. He believes this should be much higher, as in many cases the nose and sinuses were not taken into consideration. Furthermore, as Axenfeld has pointed out, the sinusitis may subside as the cellulitis progresses, particularly in cases following influenza.

Most of the orbital complications are due to frontal sinus inflammation; the ethmoid follows, then the sphenoid, and finally the maxillary is occasionally the cause. A frontal involvement is indicated in swelling limited to the upper lid with the eyeball pushed down and towards the temple with crossed diplopia and vertical deviation; ethmoiditis, in swelling at the inner canthus evenly divided between the two lids, with the globe pushed towards the temple, and crossed diplopia with no vertical deviation; and a sphenoid empyema, in swelling of the lower lid, a predisposition to chemosis in the lower quadrant of conjunctiva.

Emphysema of orbit or lids may be due to fracture of a portion of the nasal wall of the orbit, usually the ethmoid. It also occurs from inflammatory conditions. Collections of fetid gas with pus in the orbit have been found by Grandclemont and Guyot to be of ethmoid origin.

Cases of blepharospasm have been reported in which relief was secured only when some accompayning nasal irritation was removed.

Exophthalmic goiter with complete subsidence of the exophthalmos has been cured by nasal operation. On the other hand, the exophthalmus has also been reported as having immediately followed a nasal operation. The tonsil relations of goiter are now being studied by a number of investigators.

Thrombophlebitis of the ophthalmic plexus has been found as a complication in inflammation of the posterior ethmoid or the sphenoid. Embolism of the arteria centralis retinæ

and thrombosis of the central vein have been reported following sinusitis operations and paraffin injections for correcting nasal deformities. Wiener has seen a case of the embolism of the central artery of the retina occur immediately after injection of hard paraffin for cure of saddleback nose.

Paraffinomata of the lids have also occurred after injection of hard paraffin into the nose, causing partial or complete closure of the lids with more or less permanent defects.

4. Muscles. Abducens paralysis in connection with suppurative otitis media has already been considered.

Paralysis or paresis of the fourth, or one or more branches of the third nerve, is a common complication of orbital abscess or cellulitis due to sinusitis, and paralysis of the fourth frequently results from a Killian operation. These muscle paralyses have often been permanent, although they may be merely transitory. The asthenopia often observed in patients suffering from nasal affections can be ascribed to a fatigue of the accommodation branch of the third, without producing an actual paralysis of accommodation.

5. Conjunctiva and Cornea. Inflammation of the conjunctiva or cornea must not necessarily be set down as due to nasal inflammation merely because of concommitance, for they may both be complications of measles, pemphigus, tuberculosis or syphilis.

Various forms of conjunctivitis and keratoconjunctivitis, especially the phlyctenular variety, have been reported as being caused by nasal and sinus disease. Corneal ulcer and herpes of the cornea and lids have been relieved by treatment of the nose and sinus and the removal of tonsils and adenoids. We have found that stubborn forms of dendritic keratitis, such as are not generally recognized as being of nasal origin, are relieved promptly by appropriate treatment of the nose.

Keratitis lisceformis has been reported by Elschnig as caused by sinusitis. He does not venture to ascribe the manner in which the sinus causes the condition.

6. Uveal Tract. Ophthalmologists have only in recent years awakened to the importance of looking to focal infection as a cause of iritis and uveitis. Diseased sinuses and tonsils have been found largely responsible for a great number of cases of anterior and posterior uveitis. Startling cures of acute,

chronic and recurrent cases have been recorded after removal of diesased tonsils, whereas all previous efforts at effecting a cure had failed. We have had a marked case of this type.

Increased intraocular tension may have a nasal origin. We have under observation at the present time two cases of glaucoma, one a woman, 45 years of age, who had been operated upon for cataract in the left eye and now has cataract with glaucoma in the right eye, was immediately relieved of pain with a temporary reduction of intraocular tension to normal by shrinking the middle meatus with cocain. She is already greatly improved since clearing out the diseased ethmoid cells on her right side, and we are watching with interest the ultimate outcome. The second patient, a case of glaucoma, with recurrent large blebs upon the cornea, has just been operated upon for a deflected septum. The ethmoid cells on that side were found to be diseased, but will be taken care of later. This patient also had been greatly improved temporarily by shrinking the mucous membrane of the nose.

While the contention of Ziem that cataract can be caused or at least influenced by sphenoid or ethmoid sinus disease leaves some room for doubt, Pauntz and others have unquestionably demonstrated the influence of sinusitis on postoperative cataract infection.

Hyalitis and muscae volitantes are among the conditions that have disappeared upon relieving the nasal lesion.

With sympathetic ophthalmia there is a recognized thickening of the nasal mucosa. Some authorities have held the sinuses to be the cause in a number of cases. Two are cited by Elschnig of sympathetic irritation occurring three months after enucleation, entirely cured with restored vision following treatment of the sinuses. Two reported by Moulton at the last meeting of the American Medical Association seem to be due to similar cause.

7. Optic Nerve and Retina. This is of the most vital importance, as often the question of sight or blindness rests with prompt diagnosis. Most of the cases of blindness relieved by nasal operation come within this group. Retinal hemorrhages and inflammations, retinal detachment and neuroretinitis have all been found to be due to sinus disease and infected tonsils.

We are mostly concerned, however, with optic neuritis and retrobulbar neuritis.

Evans and Fish tabulated 36 consecutive cases of optic neuritis. Sinus disease was present 26 times. Elschnig found sinus involvement in 15 per cent of all optic nerve affections.

Only a small percentage of these cases give a history of nasal trouble. There is nothing significant about the appearance of the nerve, as there may be any condition present, from a normal nerve head in retrobulbar neuritis to a choked disc, either due to sinusitis or other causes. The diagnosis is particularly difficult when sinusitis is present with some other (nerve) disease. The mere presence of tabes in a case of atrophy, or active syphilis in a case of optic neuritis, should not exclude the sinuses as having an important bearing on the neuritis. On the other hand, the association of sinusitis with optic neuritis should not deter the physician from going through the routine in an effort to discover all possible determining causes.

Van der Hoeve believes that enlargement of the blind spot, first for colors and later for white, is the first sign of retrobulbar neuritis of nasal origin. He believes that this always is the precursor of a central scotoma and could be found often if a careful and early search were made.

Elschnig does not attach much significance to enlargement of the blind spot, as it is an accompanying sign of toxic amblyopia. However, the latter can usually be eliminated by a history of the case. He believes with Fuchs that central scotoma for colors and then white is one of the earliest signs. de Kleinj, however, has verified the work of Van der Hoeve and thinks that we have in this a most valuable means for an early diagnosis, even though it may not be constant.

Ziem considers a peripheral contraction of the fields of vision common, but has received little support. Other scotomata besides the natural blind spot are sometimes found in the field. Bitemporal hemianopsia is a rare accompaniment.

Retrobulbar neuritis with resulting atrophy of the optic nerve has often been seen following fracture by blow on the orbital edge extending along the nasal wall of the orbit to the canalus opticus, and has even been reported following oper-

ation on the septum or removal of a spur or turbinate bone, causing fracture extending to the optic canal.

Optic atrophy following retrobulbar neuritis in "tower skull" has been discussed by Posey and Berger, who believe it to be due to the encroachment of bone on the optic canal and sphenoid fissure the result of enlargement of the sphenoid bone with advancing years.

It must not be forgotten that in optic nerve atrophy with bitemporal hemianopsia due to tumor of the hypophysis, the growth sometimes reaches downward into the sphenoid and may be mistaken for primary sphenoidal growth. In such a case which was under observation (Wiener) a craniectomy was unsuccessfully made, and on postmortem examination it was found that the growth extended deeply into the sphenoid. If the sinuses had been previously examined in this case, much valuable information would have been available.

Numerous cases of blindness from optic neuritis relieved by nasal operation reported by Risley, Onodi, Holmes, Evans, Fish, Elschnig, Hansell, Van der Hoeve, de Schweinitz, Sluder, Knapp, Loeb, Ring, and many others leave no doubt that there are many minor defects of vision which are dependent on nasal lesions and for which no relief is possible, except through proper attention to the nose and paranasal sinuses.

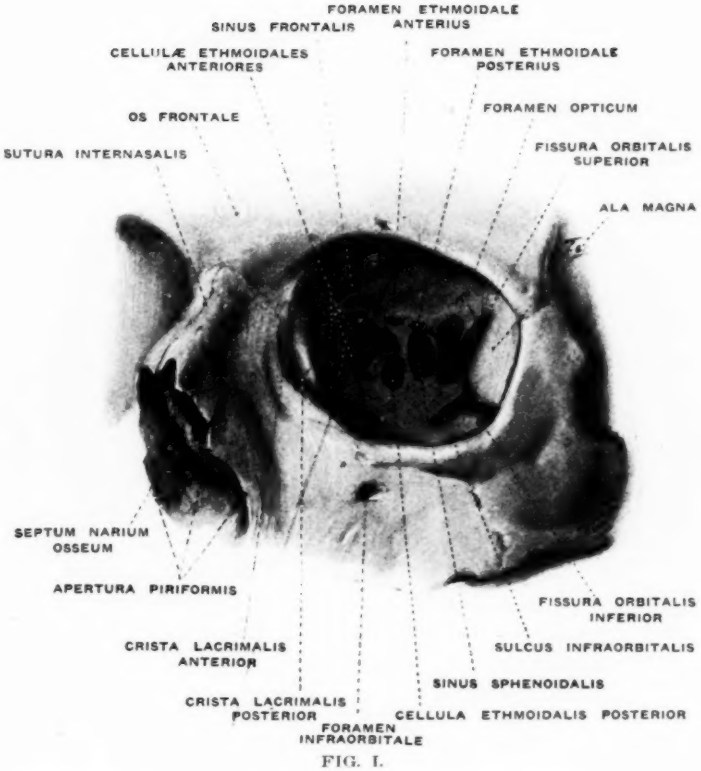

FORAMEN ETHMOIDALE ANTERIUS
SINUS FRONTALIS
CELLULÆ ETHMOIDALES ANTERIORES
FORAMEN ETHMOIDALE POSTERIUS
OS FRONTALE
FORAMEN OPTICUM
SUTURA INTERNASALIS
FISSURA ORBITALIS SUPERIOR
ALA MAGNA
SEPTUM NARIUM OSSEUM
APERTURA PIRIFORMIS
FISSURA ORBITALIS INFERIOR
CRISTA LACRIMALIS ANTERIOR
SULCUS INFRAORBITALIS
SINUS SPHENOIDALIS
CRISTA LACRIMALIS POSTERIOR
CELLULA ETHMOIDALIS POSTERIOR
FORAMEN INFRAORBITALE

FIG. I.

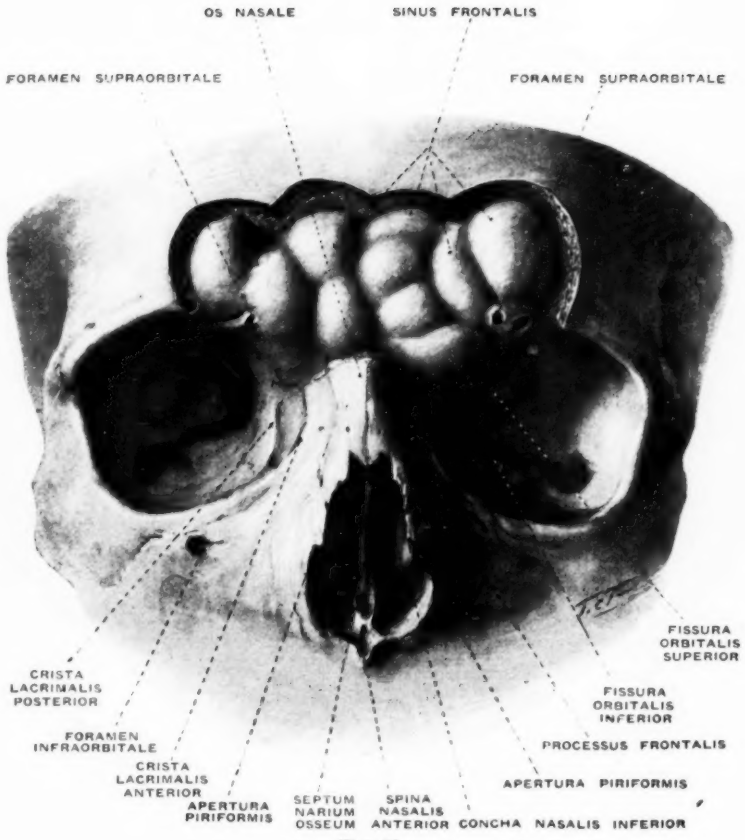

OS NASALE
SINUS FRONTALIS
FORAMEN SUPRAORBITALE
FORAMEN SUPRAORBITALE
FISSURA ORBITALIS SUPERIOR
CRISTA LACRIMALIS POSTERIOR
FISSURA ORBITALIS INFERIOR
FORAMEN INFRAORBITALE
PROCESSUS FRONTALIS
CRISTA LACRIMALIS ANTERIOR
APERTURA PIRIFORMIS
APERTURA PIRIFORMIS
SEPTUM NARIUM OSSEUM
SPINA NASALIS ANTERIOR
CONCHA NASALIS INFERIOR

Fig. II.

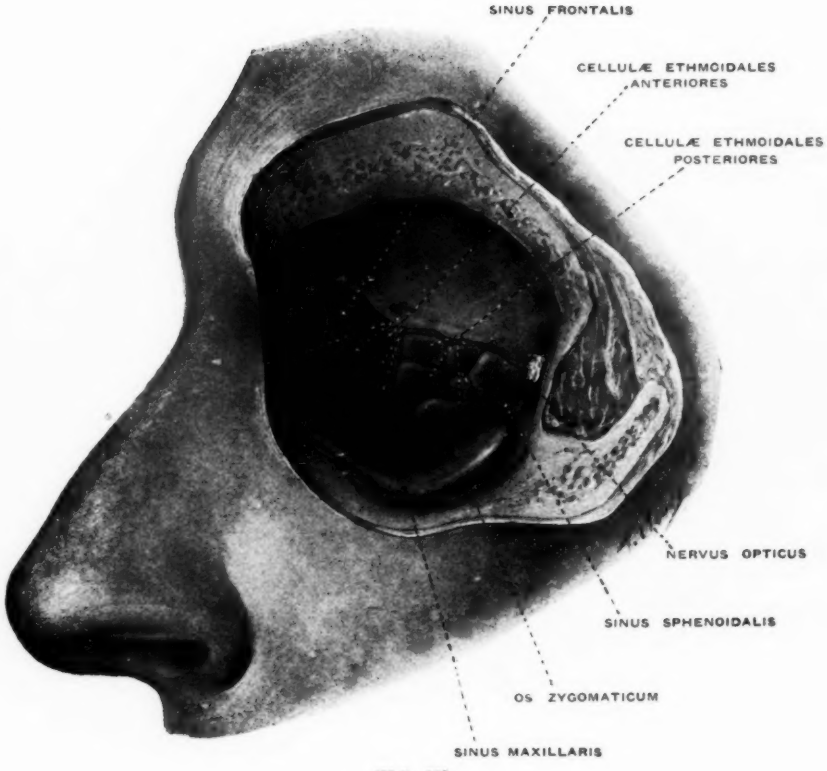

SINUS FRONTALIS
CELLULÆ ETHMOIDALES ANTERIORES
CELLULÆ ETHMOIDALES POSTERIORES
NERVUS OPTICUS
SINUS SPHENOIDALIS
OS ZYGOMATICUM
SINUS MAXILLARIS

FIG. III.

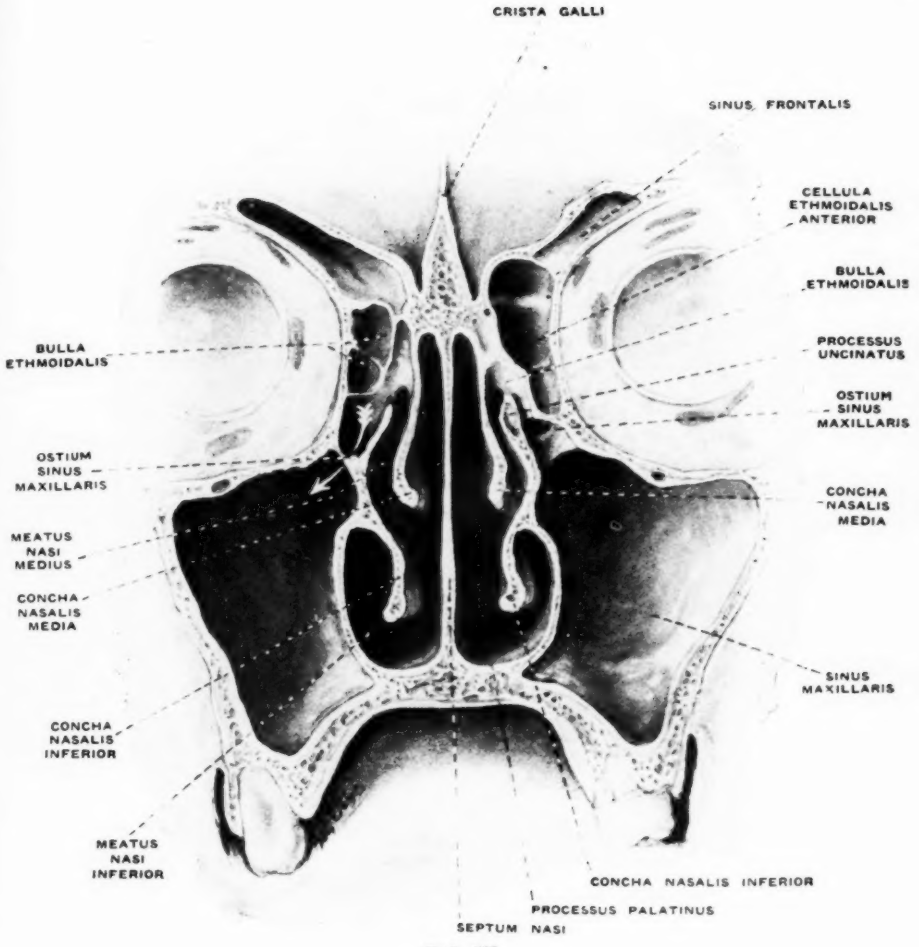

CRISTA GALLI
SINUS FRONTALIS
CELLULA ETHMOIDALIS ANTERIOR
BULLA ETHMOIDALIS
PROCESSUS UNCINATUS
OSTIUM SINUS MAXILLARIS
CONCHA NASALIS MEDIA
SINUS MAXILLARIS
CONCHA NASALIS INFERIOR
PROCESSUS PALATINUS
SEPTUM NASI
MEATUS NASI INFERIOR
CONCHA NASALIS INFERIOR
MEATUS NASI MEDIUS
CONCHA NASALIS MEDIA
OSTIUM SINUS MAXILLARIS
BULLA ETHMOIDALIS

FIG. IV.

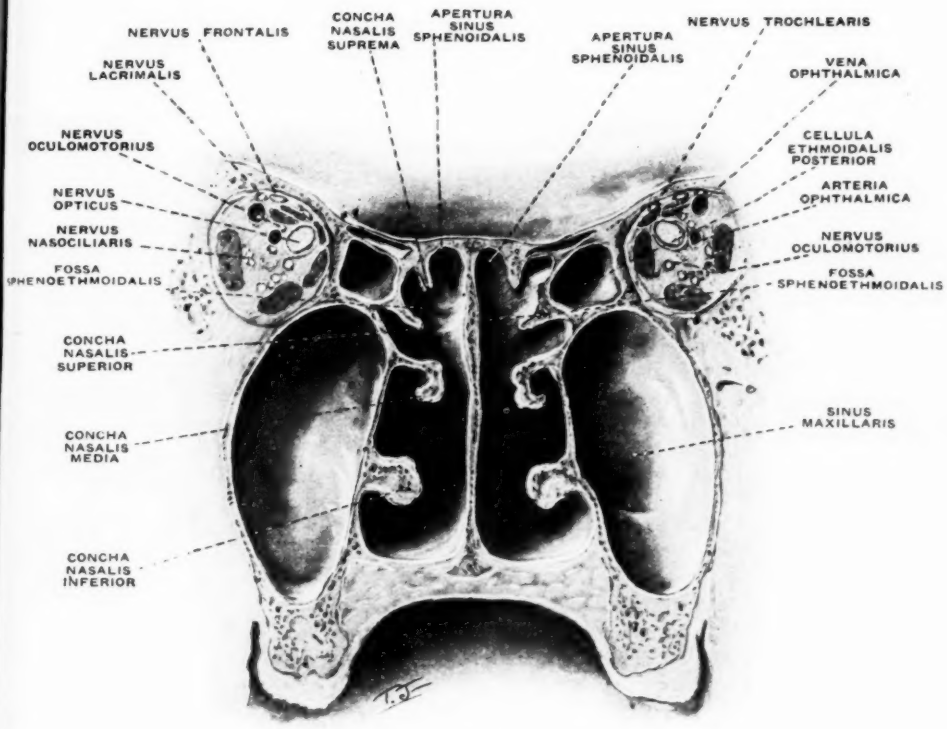

NERVUS FRONTALIS
CONCHA NASALIS SUPREMA
APERTURA SINUS SPHENOIDALIS
APERTURA SINUS SPHENOIDALIS
NERVUS TROCHLEARIS
NERVUS LACRIMALIS
VENA OPHTHALMICA
NERVUS OCULOMOTORIUS
CELLULA ETHMOIDALIS POSTERIOR
NERVUS OPTICUS
ARTERIA OPHTHALMICA
NERVUS NASOCILIARIS
NERVUS OCULOMOTORIUS
FOSSA SPHENOETHMOIDALIS
FOSSA SPHENOETHMOIDALIS
CONCHA NASALIS SUPERIOR
SINUS MAXILLARIS
CONCHA NASALIS MEDIA
CONCHA NASALIS INFERIOR

FIG. V.

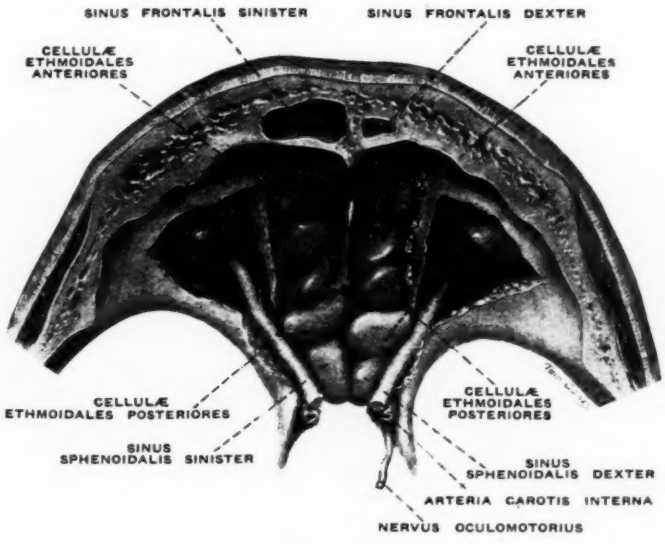

SINUS FRONTALIS SINISTER
SINUS FRONTALIS DEXTER
CELLULÆ ETHMOIDALES ANTERIORES
CELLULÆ ETHMOIDALES ANTERIORES
CELLULÆ ETHMOIDALES POSTERIORES
CELLULÆ ETHMOIDALES POSTERIORES
SINUS SPHENOIDALIS SINISTER
SINUS SPHENOIDALIS DEXTER
ARTERIA CAROTIS INTERNA
NERVUS OCULOMOTORIUS

FIG. VI.

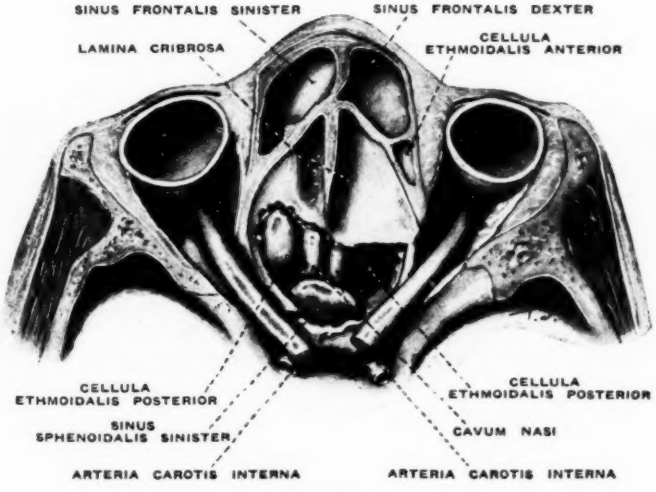

SINUS FRONTALIS SINISTER
SINUS FRONTALIS DEXTER
LAMINA CRIBROSA
CELLULA ETHMOIDALIS ANTERIOR
CELLULA ETHMOIDALIS POSTERIOR
CELLULA ETHMOIDALIS POSTERIOR
SINUS SPHENOIDALIS SINISTER
CAVUM NASI
ARTERIA CAROTIS INTERNA
ARTERIA CAROTIS INTERNA

FIG. VII.

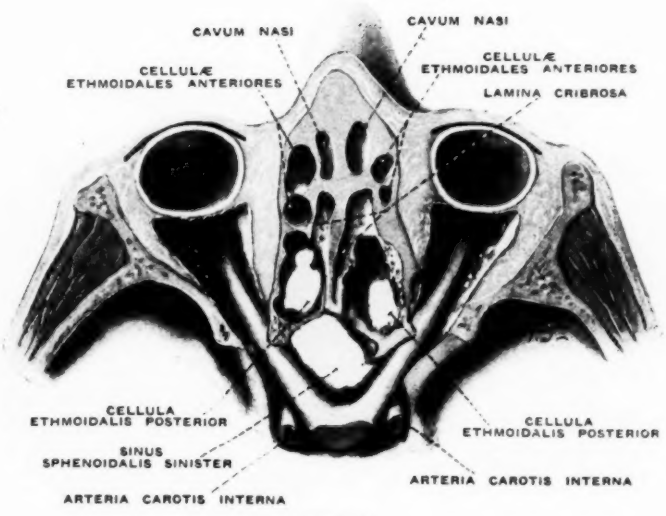

CAVUM NASI
CAVUM NASI
CELLULÆ ETHMOIDALES ANTERIORES
CELLULÆ ETHMOIDALES ANTERIORES
LAMINA CRIBROSA
CELLULA ETHMOIDALIS POSTERIOR
CELLULA ETHMOIDALIS POSTERIOR
SINUS SPHENOIDALIS SINISTER
ARTERIA CAROTIS INTERNA
ARTERIA CAROTIS INTERNA

FIG. VIII.

III.

OBSERVATIONS ON THE DEVELOPMENTAL ANATOMY OF THE TEMPORAL BONE.*

By Lee Rogers, M. D.,

FROM THE INSTITUTE OF ANATOMY AND THE DEPARTMENT OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

The purpose of this paper is to record a series of observations on the development of the temporal bone in later fetal life and childhood, and to consider the varying relations of its several parts at different ages, with particular reference to their surgical significance.

The study has been limited, in the main, to those phases of the subject concerning which our information is obviously incomplete or upon which there exists a decided difference of opinion.

MATERIAL AND METHODS.

A considerable amount of material was available for this study, including 294 temporal bones, some dried and some fresh and in situ, as well as a series of 32 skulls in various stages of development. Of the temporal bones, 14 were of fetal stages, 32 of newborn children, 18 of children of different ages (2 to 15 years, inclusive) and 230 of adults.

Of the skulls 14 were fetal, 14 were newborn, and 4 were of children. There was also available a large series of adult skulls for comparison with those of earlier stages.

To insure exactitude of measurements, and to determine accurately the relations of the various parts of the organ of hearing, the subject has been attacked with a variety of methods.

First, a series of casts in Wood's metal were prepared, reproducing the cavities of the external, middle and internal ear, together with the nerves, air cells, osseus auditory tube, tensor tympani muscle, carotid artery, aqueducts, etc. In all, 40 such

*Graduate thesis for Master's Degree in Ophthalmology and Otolaryngology Graduate School, University of Minnesota.

casts were prepared. Fifteen of these were of adult ears, 5 of children, 10 of newborn infants, and 10 of fetuses. Drawings of some of these preparations are shown in Figs. 1 to 14, inclusive.

Second, the antra of a series of temporal bones were filled with bismuth paste and radiographed to show their position at different ages. As a check on this procedure, the antra were later transilluminated by introducing the small electric light of a bronchoscope tube in the cavity of each bone and tracing the outline on the surface. In older children and adults an opening was drilled through the tegmen tympani into the antrum to admit the light. In the fetus and infant the antrum could be reached through the external meatus.

The size and position of the antra were determined by radiography and transillumination in 40 bones (10 adults, 7 children, 8 newborn infants and 15 fetuses). Drawings of these specimens are shown in Figs. 15 to 24, inclusive.

Third, to determine the relations of the inner structures of the ear to surface landmarks, a series of casts in Wood's metal was prepared and the bone in these specimens was later rendered transparent by the Spalteholz clearing method so that the cochlea, antrum, nerves, air cells, etc., could be observed in situ. Three of these preparations were made. Of these, one was of an adult, one of a child, three years old, and one of a newborn infant (Figs. 25 and 26).

Fourth, to further determine the relations of the antrum, facial nerve and other structures to the surface landmarks, regional dissections were made on the cadaver. Of these 8 were of the adult, 2 of children, and 8 of newborn infants. The angle of inclination of the tympanic membrane was also determined in 55 ear drums. Of these 6 were adult, 4 children, 24 newborn and 24 fetuses. As a check on measurements and relations, 32 temporal bones were sectioned in various planes. Of these 20 were adult, 2 children and 10 newborn infants.

The value of the study of the middle and inner ear by means of casts has long been recognized. As the pneumatic cavities of the ear are rather complicated in shape, it is only by representing these spaces as solids that one can obtain a clear concept of their precise form and extent, and of their

relations to one another and to the neighboring nerves, vessels and other structures. Only by a clear knowledge of the intimate topographical relations of the middle ear to the surrounding cavities is the significance of the frequent inflammations of the former fully understood.

A variety of materials have been used to replace the air spaces in making casts. Benzold used a mixture of wax and resin, Von Stein employed a rubber and chloroform solution, and then vulcanized the mass. Bruhl cleared the bone and injected mercury. James Brown[3] injected dental rubber and vulcanized. Wood's metal seems to give the most satisfactory results for this type of preparation, and certain refinements of the method introduced here have been found of considerable value in securing more perfect and complete specimens.

TECHNIC OF MAKING CASTS OF THE TEMPORAL BONE WITH WOOD'S METAL.

To make casts of the middle and inner ear, it is best to secure well dried temporal bones in which the nerves and mucous membrane of the cavities have disintegrated and disappeared, so that the canals will be clear. If any of these dessicated tissues remain, they should be removed with the air blast. The canals and nerve openings are then covered with adhesive tape, with the exception of the external auditory meatus, which is left open. After heating the encased bone at about 100 degrees centigrade for twenty-four hours in a sand bath, it is ready to receive the molten Wood's metal* which is poured into it to the level of the suprameatal (Henley's) spine. As the bone is heated above the melting point of the metal, the latter will not solidify, and the specimen can be agitated to remove air bubbles. It is a good plan to drop a little water on the metal at the meatus to solidify it, and then the bone can be picked up, and rotated to remove the air and get the metal into all parts. After cooling, the plaster of Paris casing is removed and the specimen is placed in 30 per cent hydrochloric acid to dissolve the bone.

*Wood's metal is composed of tin, 4 parts, lead 8 parts, bismuth 16 parts, and cadmium 3 parts. It has a very low melting point, about 62 degrees centigrade.

TECHNIC OF PREPARING TRANSPARENT BONE SPECIMENS.

The method used to render the injected specimens of bone transparent, as shown in Figs. 25 and 26, is that developed by Spalteholz of Leipzig in 1906.[23]

After the temporal bone is filled with Wood's metal, it is decalcified by placing it in a two per cent solution of hydrochloric acid which is changed daily for one month. It is then transferred to a one per cent solution of hydrochloric acid which is also changed daily for two weeks. The purpose of this procedure is to secure complete decalcification of the bone without destroying the specimen with the acid. The bone is then washed in running water for two weeks, or until it gives a neutral reaction to blue litmus, after which it is bleached for two hours in hydrogen peroxid and again washed. After bleaching the specimen is again washed, and is then dehydrated by passing it through a series of graded alcohols of 60, 75, 95 and 98 per cent. It should be left in each mixture about 24 hours. After dehydration, the specimen is cleared by placing it in benzol for four days, changing the solution at the end of 48 hours. The final preserving fluid in which the specimen is to remain consists of methyl salicylate 5 parts, and isosafrol 3 parts. As these fluids have the same refractive index as the prepared bone the latter becomes translucent. Sometimes it may be made more transparent by adding a little more isosafrol. Air bubbles may be removed by placing the specimen under a bell jar and exhausting the air with a suction pump.

OBSERVATIONS—THE MEMBRANA TYMPANI.

Upon examination of the literature on the tympanic membrane, one is confronted with a great variance of opinion regarding the inclination of this structure. Observers seem to be about equally divided as to whether the inclination in the newborn is equal to, or less than that of the adult, and several maintain that the ear drum is almost horizontal at birth.

The angle given by Lucian for the adult is 55 degrees. Howell[27] 130, Flint[27] 45, Kirk[27] 45, Piersol[27] 60, Gray[27] 55, Morris[27] 50, Freiligh[11] 50, Symington[20] 45, and Pollak[25] 45. Shaw,[18] Gray,[27] Henle,[24] von Troltsch, Trevis,[22] Gruber[26] and Cheatle[7] state that the tympanic membrane is nearly horizontal at birth, while Symington,[20] Pollak,[25] Cavanaugh[6] and Freiligh[11] main-

tain that the angle in the adult and newborn is about the same. The data obtained by the measurement of individual ear drums in this study is shown in the following table. (Table No. 1.) The figures indicate the degree of inclination from the perpendicular. The measurements as given in Table No. 1 show that a large individual variation is frequent in both newborn and adult drums. The averages show the membrane approaches a little more closely the horizontal in the fetus and that it gradually becomes more erect in later fetal life. There seems to be no constant change in the angle afterbirth.

The angles given in the following tables were determined with the Stangen goniometer of Martin and Ranke.

TABLE No. 1.

Inclination of the Tympanic Membrane.

Age	Individual Cases	Ave. Deg. of Inclina'n
Four months fetus	61, 63	62
Five months fetus	55, 57, 60, 62, 72, 80	64.4
Six months fetus	58, 59, 60, 64, 64, 65	61.5
Seven months fetus	55, 60, 61, 62, 63	60.2
Eight months fetus	58, 59, 60, 65, 65	61.4
Nine months fetus	55, 57, 57, 61, 62, 63, 63, 68	60.8
Newborn	54, 55, 56, 57, 58, 58, 60, 60, 65	57
Child of three years	55, 60	57.5
Adult	45, 55, 57, 60, 60, 69	57.5

TABLE No. 2.

Dimensions of the Tympanic Membrane.

Age	Diameters (mm.)	Ave. Diam. (mm.)
Fourth fetal month	Max. 6.8, 6.8	6.8
	Min. 5.5, 5.5	5.5
Fifth fetal month	Max. 7.1, 7.5, 7.5	7.4
	Min. 6, 6, 6.5	6.2
Sixth fetal month	Max. 7.2, 7.3, 7.8, 8	7.6
	Min. 6.3, 6.6, 6.6, 7.5	6.7
Seventh fetal month	Max. 7.8, 8, 9	8.3
	Min. 7.6, 7.7, 7.8	7.7
Eighth fetal month	Max. 8, 9, 9.6	8.9
	Min. 8, 8, 8.3	7.8

Ninth fetal month—Max. 9, 9, 9.2, 9.7, 10	9.3
Min. 7.5, 8, 8, 8.5, 8.5, 9	8.2
Newborn—Max. 9, 9, 9.3, 9.5, 9.5, 9.8, 10, 10, 10, 10, 10, 10.2, 10.3, 10.3	9.8
Min. 7.8, 8, 8, 8, 8, 8, 8, 8.2, 8.3, 8.4, 8.4, 8.6, 8.8	8.2
Seventh month child—Max.	11.
Min.	8.5
One year child—Max.	11.
Min.	9.
Two year child—Max.	11.
Min.	9.
Adult—Max.	11.
Min.	9.

As these measurements were taken to the extreme edge of the sulcus tympanicus they will be found to be slightly larger than the drum membrane proper.

It is generally stated that the dimensions of the tympanic membranes at birth are almost identical with those of the adult, there being little or no increase in the postnatal period of development. The figures quoted in Table No. 2 show that the tympanic membrane increases steadily in size in the last half of fetal life and that also there is a distinct increase in its diameter in the first year after birth, at the end of which period the adult dimensions are attained.

THE ANTRUM.

The "mastoid" antrum should be called the tympanic antrum because, considered from any point of view, it is a part of the tympanic cavity. The antrum appears in the fetus at the same time as the tympanic cavity, and at the time of birth is developed to about adult dimensions, but the mastoid cells do not appear until the second year, and they are generally diploetic till the fifth. Definite air cells first appear at the seventh or eighth year, and are first seen as well developed spaces after the ninth year. The antrum must also be considered at all stages as continuous with the tympanic cavity and as lying entirely within the petrous bone. It is covered by the tegmen tympani, which also is the roof of the tympanic cavity and the auditory tube.

The relations of the antrum to its adjacent structures varies considerably at different ages. Up to the time of birth it is directly over the meatus, its upper part lying above the zygomatic process and its anterior margin extending forward beyond that of the meatus.

In the fetus and newborn the incus lies in the aditus and its long process projects into the antrum. As shown in Figs. 15 to 24 inclusive, as the child grows older the antrum gradually shifts from its location above the meatus to a more posterior and inferior position, and in the adult it is directly posterior to it. Its position in the child materially aids drainage in acute infections.

The lateral (external) canal of the bony labyrinth forms the inner boundary between the antrum and epitympanic recess. Its bony covering is easily recognized as a thin white ridge of dense bone. In the young child its wall is only about one-fifth of a millimeter in thickness, and a probe or curette introduced into the middle ear could easily rupture into the canal.

The thickness of the bone separating the antrum and lateral canal at different ages is approximately as follows:

Newborn, 0.2 mm.; three years old, 0.3 to 0.5 mm.; five years old, 0.5 mm.; adult, 1 mm.

As the mastoid develops, the antrum becomes farther and farther removed from the external surface of the temporal bone. The thickness of the bony wall bounding the lateral surface of the antrum at different ages is approximately as follows:

Newborn, 1 to 2 mm.; five years old, 6 mm.; ten years old, 10 mm.; adult, 15 mm.

The above figures are about the same as those given by Symington (20). The dimensions of the antrum in the newborn are about 10 by 11 mm., which is approximately the same as in the adult.

THE FACIAL NERVE.

The general course and relations of the facial nerve in the temporal bone are much the same in the infant and adult, and there seems to be a consistent and uniform growth of its parts. The distance from the nerve's entrance into the inter-

nal auditory meatus to the central point of the geniculate ganglion is shown in the following:

Five month fetus, 8 mm.; seven month fetus, 9 mm.; newborn (average of ten cases), 10 mm.; three year child, 12 mm.; adult (average of ten cases), 13 mm.

The distance from the center of the ganglion to the point where the nerve turns sharply downward is 10 mm. in the newborn, 11 mm. at three years, and an average of 12 mm. in the adult. This portion of the nerve lies within the tympanic cavity, and in its course over the promontory around the fenestra rotundum it is protected only by a thin shell of bone in the adult, and in the child up to the fourth year it is often covered only by a thin membrane of connective tissue. This exposed condition accounts for the liability to facial paralysis in the child following acute otitis media. As the nerve runs directly beneath the anterior part of the external (horizontal) canal, a roughly used probe or Staeke's director for locating the epitympanic recess may easily injure it. As Cheatle[2] aptly says, "Such an instrument is safe only in experienced hands, and then it is not needed."

The course and relations of the facial nerve can be best seen in the superior views of the various casts. The distance from the posterior rim of the tympanic membrane to the nearest point of the facial nerve is from 3 to 5 mm., both in the fetus and the adult.

The exposed condition of the nerve, in early life, after its exit from the stylomastoid foramen, is of importance both to the obstetrician and the surgeon. In the fetus and young infant it emerges about 3 mm. behind and a little below the most posterior part of the margin of the tympanic membrane. As there is no mastoid process at this time, the nerve runs downward over the petrous portion of the bone. This condition accounts for some of the facial paralyses produced by pressure from instruments at this point during delivery. It is also to be noted that this external portion of the nerve lies in the path of an incision such as is made in operation for mastoiditis in the adult. If such an incision were made in the infant, the nerve would be cut and a facial paralysis would result; but as the antrum in the young child is much higher, and as there is no mastoid containing air cells, there is little

need for such an incision. The relations of the exit of the facial nerve, the antrum, the tympanic membrane, and the developing mastoid process, are shown in Figs. 15 to 24 inclusive.

After the first year the vertical portion of the facial nerve is gradually covered by the deposit of the layers of bone forming the mastoid process, and by the outward growth of the posterior portion of the tympanic ring, which forms the external osseous meatus. The thickness of the bone over this portion of the nerve is shown by the following measurements: One year: 0 mm.; three years, 6 to 10 mm.; five years, 11 mm.; adult, 13 to 15 mm.

In all fetal and infant specimens examined the nerve came straight to the surface, but, as Freiligh[11] states, in some cases the nerve bends downward before emerging, and in these cases the exit would be two or three millimeters lower.

THE INNER EAR.

If lines were projected through each posterior canal, they would meet a little posterior to the hypophysis and form approximately a right angle. Likewise, lines through the superior semicircular canals would meet above the posterior rim of the foramen magnum and be about at right angles to each other. It can be seen that the canals of one side are at right angles, and that either canal of one side is at right angles to its mate on the other side. This makes the posterior canal of one side parallel to the superior canal of the other and vice versa. This is shown in Figs. 29 to 30.

Upon measurement it will be found that in only about a third of the cases will these angles be exactly 90 degrees. Other cases will vary 10 degrees above or below.

The lines projected through the superior canal of the newborn meet within the foramen magnum, while in the adult they meet well back of it. This is partly due to the fact that the foramen magnum is farther posterior in the infant skull and partly because the superior canal lies more nearly in the transverse plane. The lines running forward through the posterior canals of the newborn meet in the region of the clivus, while in the adult they meet farther forward in the region of the sella turcica. This is also due to the fact that the posterior

canal of the newborn lies more nearly in the transverse plane than that of the adult.

Alexander[1] and Shaw[18] found the adult inner ear larger than that of the newborn. Booth[3] found the postembryonic growth to be about 18 per cent. Hyrtle found the inner ear of the adult and child about the same size, but that there is an increase in size in old age. The diameters at different ages is shown in Tables Nos. 3 and 4.

The inner ear changes but little in size after the fifth fetal month, as is shown in the following tables (Nos. 3 and 4):

Maximum Length of Inner Ear, Including Cochlea, Vestibule and Posterior Canal.

TABLE No. 3.

	Present series mm.	Alexander[1] mm.	Seibenmann[17] mm.	Shaw[18] mm.
Five month fetus	18			
Seven month fetus	18			
Newborn	17	15	19	18
Three year old	18			
Five year old	16			
Adult	18	18	18.5	20

TABLE No. 4.

Diameters of the Inner Ear Parts at Different Ages.

	Vertical diam. of cochlea mm.	Horizl. diam. of sup. canal mm.	Ant. post. diam. of ext. can. mm.	Vertical diam. of post. canal mm.
Five month fetus	7.5	8.	7.	8.
Seven month fetus	7.	7.5	7.	
Newborn	7.	8.5	7.	7.25
Three year old	7.5	8.25	7.	
Five year old	7.5	8.5	7.	8.
Adult	7.5	8.5	7.	8.
Seibenmann[17] Newb'n	7.7	8.8	8.1	7.2
Adult	7.5	8.6	7.2	7.2
Shaw[18] Newborn		5.		
Adult		6.		

The distance of the horizontal canal from the cortex in the infant is from 4 to 6 mm., while in the adult it is from 12 to 20 mm. The horizontal canals and the oval window are the most frequent points of entrance for infection. The angles of the semicircular canals to each other and their positions in relation to the rest of the skull are shown in Figs. 29 and 30.

The relation of the semicircular canals to each other is shown in the following table. The figures indicate the degree of the angle. (From Siebenmann[17]):

	Superior to external	Superior to posterior	Posterior to external
Adult	82	79	99*
Newborn	85	88	92

Most grateful thanks are due Professor Scammon for many helps in securing data and criticising the text of this paper.

REFERENCES.

1. Alexander, G.: Zur Frage des postembryonalen Wachstums des menschlichen Ohrlabrinthes. Anat. Hefte., XIX (1902), pp. 571-578.

2. Alexander, G.: Diseases of the Ear in Infancy and Childhood, translated by A. Bedell, Sec. Edit., pp. 1-46.

3. Boot, G. W.: Development and Structure of the Temporal Bone, Journ. Amer. Med. Assn., LV, pp. 563-565.

4. Brown, H. P.: The Infant Temporal Bone in Its Relation to the Mastoid Operation. Bull. Lying-In Hosp., City of New York; Vol. IX (1913), p. 11.

5. Brown, J.: Bull of Med. Dept. of Wash. Univ., Vol. IV, No. 1, Aug. (1905).

6. Cavanaugh, J. A.: Topography of the Tympanic Cavity, Annals of Otol., Rhin. and Laryng. (1913), Vol. XXII, pp. 699-716.

7. Cheatle, A. H.: Some Points in the Surgical Anatomy of the Temporal Bone From Birth to Adult Life; London, 1907.

8. Cheatle, A. H.: The Report of An Examination of Both Temporal Bones from One Hundred and Twenty Individuals in Reference to the Question of Symmetry in Health and Disease. Annals of Otol., Rhin. and Laryng., Vol. XXII, pp. 19-125.

9. Clark, J. J.: Some Observations on the Temporal Bone, Chiefly in Childhood. Journ. Anat. Physiol., VII N. S. (1893), pp. 411-414.

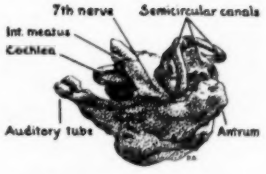
10. Courtade, A.: Anatomie topographique comparée de l'oreille moyenne chez le nouveau-né et chez l'adulte. Ann. d Mal de l'Oreille et du Larynz., XIX (1893), pp. 682-688.

*One of the angles taken in this series of four cases was of 105 degrees, which accounts for this large angle.

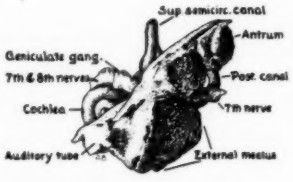
11. Freiligh, C. A.: The Temporal Bone and Its Anomalies at Birth in One Hundred Fifty Cases. Bull. Lying-In Hosp., City of New York, Vol. IX (1913), p. 3.
12. Guthierie, T.: The Development of the Mastoid, British Med. Journ., Vol. II, Oct., 1907, p. 986.
13. Metheny, D. G.: Some Points on the Applied Anatomy of the Temporal Bone. (Reprint) Penn. Med. Journ., Dec., 1915.
14. Politzer, A.: The Anatomical and Histological Dissection of the Human Ear in Its Normal and Diseased Condition. (English translation of G. Stone.) London, 1892.
15. Prinz, H.: The Spalteholz Method of Clearing Animal Bodies. Journ. of Missouri State Med. Assn., March, 1913; pp. 295-299.
16. Rouviere, H.: Sur le developpement de IV antre mastoidien et des cellules mastoidennes. Bibliogr. Anat., XX (1910), pp. 24-34.
17. Siebennann, F.: Die Korrosion-Anatomie des menschlichen Ohres. Wiesbaden, 1890.
18. Shaw, A. J.: A Few Anatomical and Clinical Points in the Ear of the New-Born Infant. Amer. Gyn. and Pediat., XIII, pp. 127-142.
19. Stewart, W. H.: Radiograph Findings Illustrating the Anatomical Development of the Mastoid Bone. Annals of Otol., Rhin. and Laryn., Vol. XXII (1913), pp. 677 and 833.
20. Symington, J.: The Mastoid Portion of the Temporal Bone, Edinburg Med. Jour., 1886; pp. 293-298.
21. Trait. d Anatomie Top., 3rd Edit.
22. Trevis, F.: Surgical Applied Anatomy, 7th Edit.; pp. 91-102.
23. Spalteholz, D. W.: über das Durchsichtigmachen con menschlichen und tiereschen Präparatin; Leipzig, 1911.
24. Henle, J.: Allgemeine Anatomie Lehre con des Menscheng und Farmbestandtheilen des menschlichen Körpers; Leipzig, 1841.
Henle, J.: Handburch der Eingeweidelehre des Menscen; 1866.
25. Pollak: Diseases of the Ear; p. 20; 1883.
26. Gruber, Jos.: Diseases of the Ear; p. 51; Sec. Amer. Edit.
27. Texts on Anatomy and Physiology:
Luciani: P. 198, Vol. IV, 1917.
Howell: P. 380, Fifth Edit.
Flint: P. 715, 1905.
Kirk: P. 739, Twentieth Edit.
Piersol: P. 1494, 1907.
Gray: P. 1125, Seventeenth Edit.
Morris: P. 1052, Fourth Edit.

PLATE No. 1.

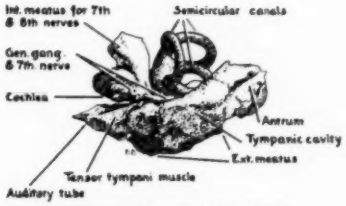
5MO. FETUS—LATERAL VIEW—(LEFT)



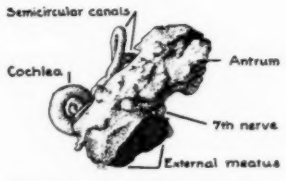
5MO. FETUS—SUPERIOR VIEW—(LEFT)



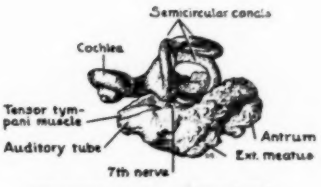
7MO. FETUS—LATERAL VIEW—(LEFT)



7MO. FETUS—SUPERIOR VIEW—(LEFT)



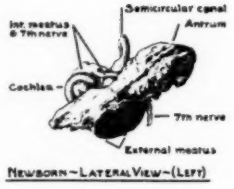
NEWBORN—LATERAL VIEW—(LEFT)



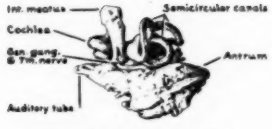
NEWBORN—SUPERIOR VIEW—(LEFT)

Wood's metal casts of internal and middle ear of fetus and newborn. X—Natural size.

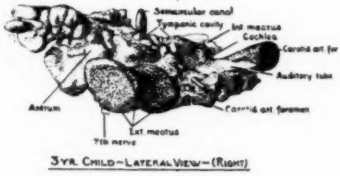
PLATE No. 2.



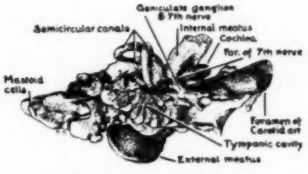
NEWBORN~LATERAL VIEW~(LEFT)



NEWBORN~SUPERIOR VIEW~(LEFT)



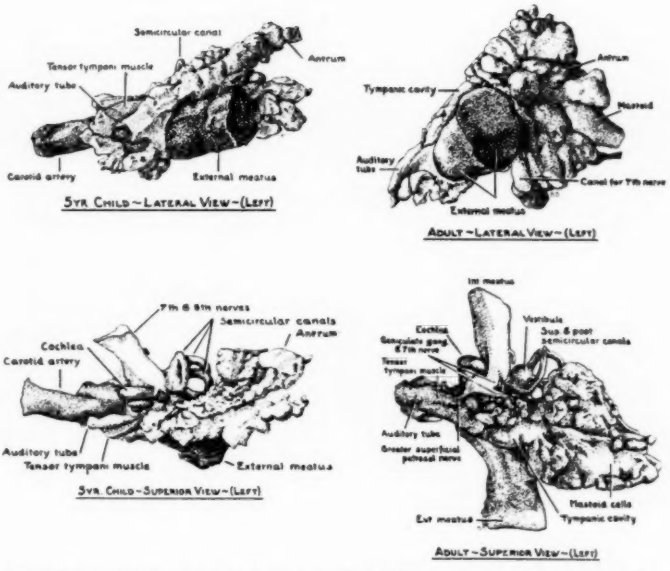
3YR. CHILD~LATERAL VIEW~(RIGHT)



3YR. CHILD~SUPERIOR VIEW~(RIGHT)

Wood's metal casts of internal and middle ear of newborn and child.
X—Natural size.

PLATE No. 3.



Wood's metal casts of internal and middle ear of child and adult. X—Natural size.

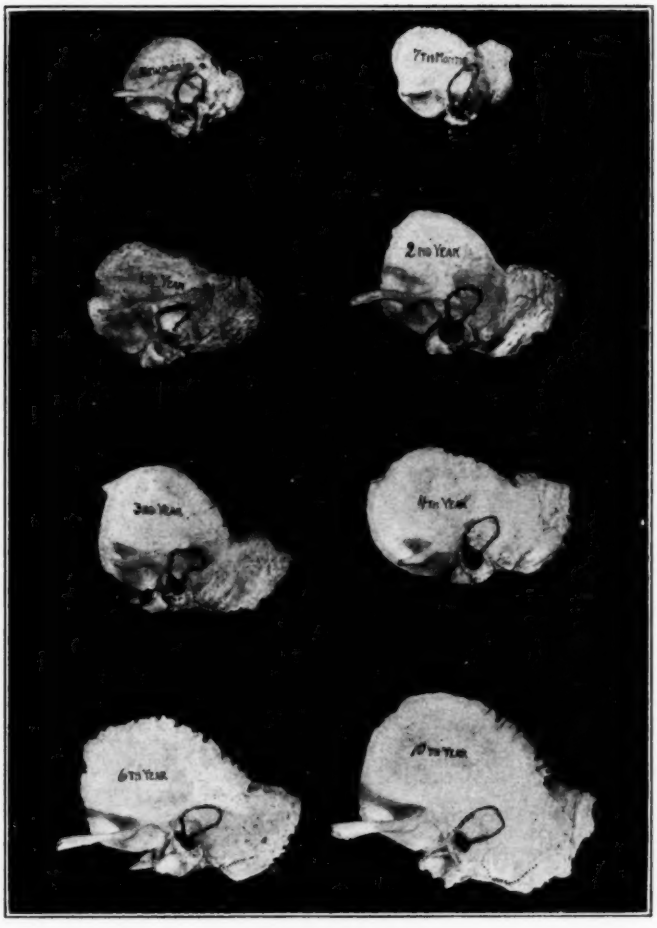


PLATE No. 4.

A series of temporal bones showing the position of the antrum as determined by X-ray and transillumination.

Fig. 15. Newborn
Fig. 16. Seven months child
Fig. 17. One year old
Fig. 18. Two years old
Fig. 19. Three years old
Fig. 20. Four years old
Fig. 21. Five years old
Fig. 22. Ten years old

PLATE No. 5.

Fig. 23. Lateral view of skull of newborn child showing position of tympanic antrum as determined by X-ray and transillumination.

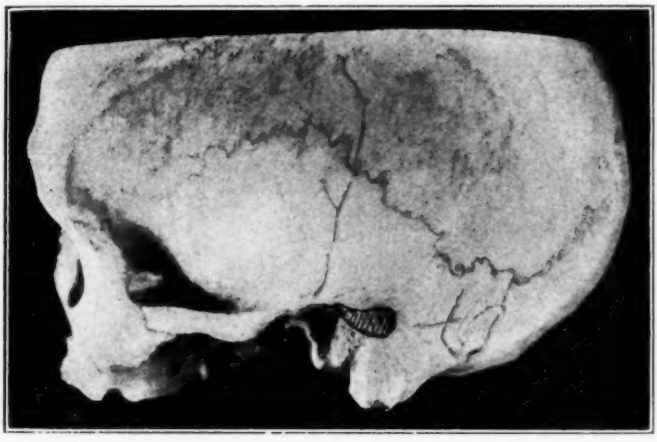


Fig. 24. Lateral view of adult skull showing position of tympanic antrum as determined by X-ray and transillumination.

PLATE No. 6.

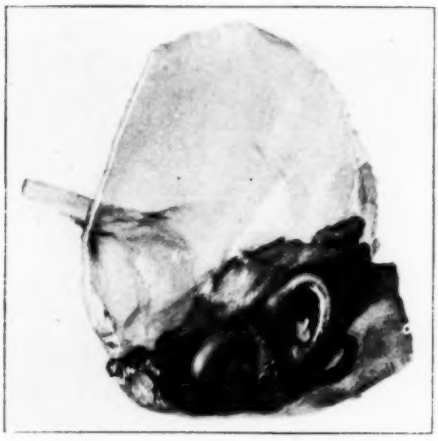


Fig. 25. Lateral view of temporal bone of newborn child which has been injected with Wood's metal and cleared with Spalteholz's method. X—1½.

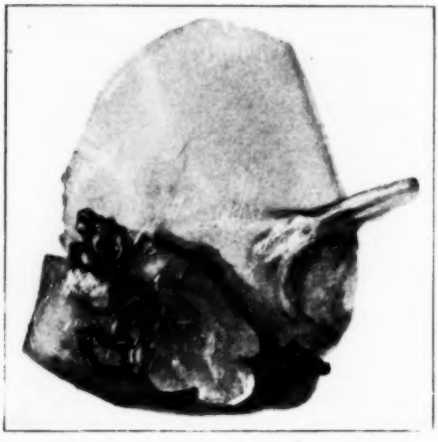


Fig. 26. Medial view of same specimen as Fig. 25. X—1½.

PLATE No. 7.

Fig. 27. Dissection showing position of antrum in relation to external osseous meatus in newborn child.

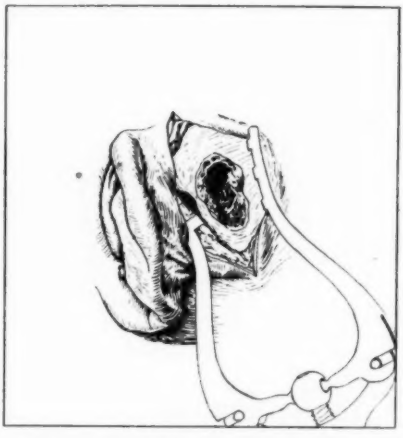


Fig. 28. Dissection showing position of antrum in relation to the external osseous meatus in the adult.

PLATE No. 8.

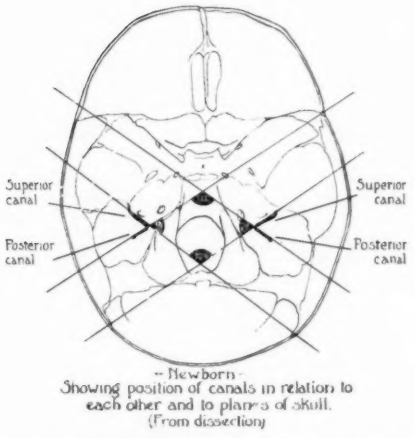


Fig. 29. Drawing of the base of the skull showing the positions and angles of the superior and posterior semicircular canals in newborn child. X—½.

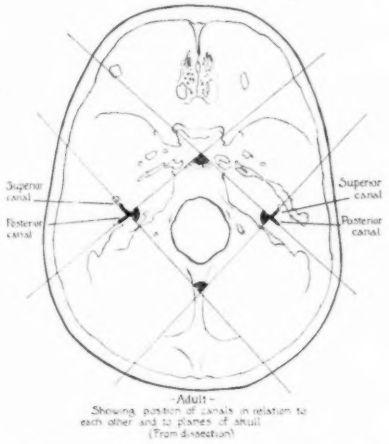


Fig. 30. Same as Fig. 29 of adult skull. X—½.

IV.

A RADICAL TREATMENT FOR CHRONIC SUPPURATION OF THE ANTRUM WITH MODIFICATION OF THE CANFIELD TECHNIC.*

By Walter H. Theobald, M. D.,
Chicago.

Infection of the maxillary sinus may be cured in several ways. First of all, by conservative methods; namely, irrigation of the antrum through the natural ostium or by means of the antrum trocar when the natural opening is inaccessible, and this often in chronic cases where the condition has been present for years. It is true that in most cases of chronic antrum disease a lasting cure is not effected by either of these methods. The tendency is for a mucopurulent discharge to recur intermittently or continue indefinitely in spite of frequent or daily irrigation with antiseptic solutions. The acute infections, as a rule, yield to the conservative method of irrigation, the time for recovery varying anywhere from one to five weeks. But in most cases of chronic disease a permanent opening into the sinus is necessary. In order to establish the latter an operation must be performed which will enable us to examine the interior of the antral cavity, watch the process of healing, remove the diseased or polypoid mucosa and maintain an opening that will not close within a few months or even a year's time. By means of such an artificial opening the patient may wash out his own antrum with ease and without discomfort.

Dr. Sturmann in his original paper published in Berlin, states that Berthe, Dehmer and others in their operations merely opened the lateral nasal wall for free drainage without affording a view of the changes in the mucous membrane. Such cases, however, in many instances, were not cured, but Sturmann by his improved intranasal operation, which gives a complete view of the antrum, was able to effect a perma-

*Read before the Chicago Laryngological and Otological Society, December 5, 1920.

nent cure. The necessity of extranasal operation on the antrum was formerly advocated where examination of the cavity for polypi, etc., was desirable, and with the publication of Canfield's and Sturmann's intranasal operations which appeared about the same time in 1908—such methods may be and have been abandoned since the intranasal route has proved so eminently satisfactory in all except some rather rare instances, such as malignant growths. This has been my experience in a series of some forty cases in which the Canfield operation was done with some slight modifications and with gratifying results.

Permit me now to review briefly the steps in the development of the various operations on the maxillary sinus. In 1889 Küster published an article on operative exposure of the antrum. This was the first operation which gave unobstructed vision during the operation and also during the after-treatment. With this method many cases which resisted conservative treatment were cured, with closure of the oral opening. Many cases, however, did not heal, even after years of treatment, and little change was observed in results, even with Jansen's improved method, because of the communication between the maxillary sinus and the oral cavity. Observing this difficulty, the intranasal operation was succeeded by the method of Mikulicz. Later the same idea was carried out in the methods used by Caldwell and Luc. Briefly, in this operation a mucous membrane incision above the alveolar margin is made and the soft parts retracted. The anterior antral wall is removed, the cavity curetted, a counter opening made into the nose, and the sinus is packed with gauze, extending into the nasal chamber and the oral mucosa sutured for primary union. Many cases recovered satisfactorily by this method, while others failed, due to the character of the chronically diseased mucosa which could not be kept under visual control.

Friedrich in 1905 departed from the methods of that time and made a skin incision around the ala. Through this he removed the anterior antral wall, lateral wall of the nose, and the pyriform process as well as the anterior half of the inferior turbinate. The danger of his method was the possibility of wound infection or scar contraction producing deformity.

Kretschman improved upon the Caldwell-Luc operation. He made the usual alveolar incision and also removed the lateral wall of the nose as far as the pyriform process, sparing the latter in order to avoid all deformity.

Later Denker combined these advantages by adding the removal of the lateral wall of the nose, including the lateral wall of the pyriform process—thereby converting the nose and the antrum roughly into one cavity. His results were promising and showed the importance of excluding the oral cavity. He reports three cases not successful because of complication involving the frontal sinus.

The advantages of the Canfield intranasal operation are several. First, a complete view of the antrum may be had at the time of the operation, and it can be made as radical as necessary through the nose—or comparatively conservative if the condition of the antrum renders an extensive operation unnecessary. Second, a satisfactory view of the antrum through the nose may be had during after-treatment for the control of the healing process. Third, the after-treatment is painless. Fourth, irrigation may be carried on by the patient.

Canfield's first step in the operation is the amputation of the anterior half of the inferior turbinate, and this he believes should precede the operation by about two weeks. I have found this unnecessary and in most cases have preserved the inferior turbinate entirely. In a few cases, however, it has been necessary to remove the anterior head where it was large and projected downward, covering most of the inferior meatus. In doing this, I have never removed the turbinate until the operation was completed, thereby obviating the danger of injuring the nasolacrimal duct. But in some of these cases we have been able to spare the turbinate by merely infracting it and pushing it upwards out of the field of operation, thus giving a clear field to work in. At the close of the operation it is restored to its normal position.

The technic of this procedure as suggested by Dr. Pierce and used by myself, is as follows: The operation is performed under local anesthesia, using 10 per cent cocain for the mucous membrane and 1 per cent novocain, to each dram of which three drops of the 1/1,000 adrenalin chlorid solution is added. Two or three drams is the amount usually necessary for com-

plete anesthesia. It is most important that the infiltration be properly performed in order to have not only a painless operation but a bloodless field to work in. For this purpose a metal syringe with extension armed with hypodermic needle is used. The injection is first made along the pyriform crest, then the lateral wall and floor of the nose are infiltrated. Lastly, the needle is introduced beneath the periostium of the external surface of the pyriform crest and the anterior surface of the maxilla. The finger placed over the cheek at this point permits one to judge the extent of the infiltration. Several injections over this area are necessary to block the nerves completely.

Next by inserting the little or index finger into the antrium nares, the exact location of the pyriform process is ascertained. It is a guide for the initial incision, which is made directly over it. The incision begins above, anterior to the point of attachment of the inferior turbinate body, and is extended well down onto the floor of the nose, bringing into view the sharp pyriform crest. The mucous membrane and periosteum are then elevated on the lateral wall of the nose from the floor up to the attachment of the inferior turbinate and backwards about one-third its distance. On the anterior or buccal wall it is elevated as far back as desirable. By means of a sharp knife or scissors a longitudinal incision is made from the upper end of the vertical incision immediately beneath the inferior turbinate attachment backwards to the point of periosteal elevation. From here it is carried down to the floor of the nose parallel to the first incision by means of a right angled knife. This makes a wide inverted U-shaped incision with the base down, and furnishes the flap which is laid down on the floor of the nose for the remainder of the operation. The next step is the removal of the bone over an area corresponding to that part from which the mucous membrane has been elevated. This is best accomplished by a Rongeur forceps, recently made by Pierce, and it is much simpler and superior to the trephine drill which I formerly used and with which one is apt to tear the flap. A Killian No. 1 speculum may be used to give a free view of the bony crest that is to be first removed, and it also aids in retracting the soft parts for examination of the cavity. After taking several bites of

bone from the pyriform process the antrum is entered without difficulty and the opening gradually enlarged in all directions so as to allow complete inspection of the sinus. At this time the antral cavity should be anesthetized. This may be done by applying ten per cent cocain with a cotton applicator or by injecting a few drops of 5 per cent cocain into the sinus with a syringe. The lateral nasal wall is removed with an antrum rasp and a biting forceps. Here the bony wall is very thin and breaks easily, while that toward the nasal floor is thick and hard to remove. But it is important that no bony projections separate the antrum from the nasal chamber—in fact, the floor of the antrum and nose must be flush or as nearly so as possible. Upon this depends much of the success of the operation. In order to remove this bone, the chisel is frequently necessary. In some cases, it has been impossible to have the antral floor and nose level, because I have found that of the antrum lower than that of the nose. With an opening thus made, a comprehensive view of the interior of the antrum can be secured and its condition noted. Polypi and degenerated mucous membranes are removed with the curette and forceps, care being taken not to remove healthy or merely swollen mucous membrane. Attention should be directed to the region of the natural opening, for this is a common seat for the origin of polypi. It is well to sponge out the antrum by packing with gauze moistened in adrenalin solution. This renders the cavity bloodless for a thorough inspection, and remnants of the diseased tissue may be removed. A final irrigation with normal salt solution removes blood and secretions. This completes the operation, and the preserved flap is turned up and placed into the antrum. It is held in place by packing the cavity with xeroform gauze.

The packing is removed after forty-eight hours, the antrum irrigated and the cavity repacked for twenty-four hours longer. Rarely do I find it necessary to tampon after removing the second packing. Sturmann repacks every other day for a period of two weeks. This causes considerable discomfort to the patient and I believe is unnecessary; furthermore, the air ventilation promotes rapid healing. The subsequent treatment consists of control of granulation tissue with silver nitrate or trichloracetic acid and irrigations until secretions

stop. An excellent astringent solution is cupric sulphate, one to six thousand, for irrigation. The usual duration until complete healing occurs is from three to five weeks.

The hole gradually becomes smaller, but the flap prevents it from closing entirely and in no case has this occurred. I have been able with perfect ease to wash out the antrum with a canula in cases operated on over three years ago. All the normal anatomic structures are preserved, and one cannot detect evidence of operation or disease except where the anterior head of the inferior turbinate has been sacrificed. I have examined cases in which a pharyngoscope could be introduced into the antrum and the cavity examined through the artificial opening two years after operation, showing that the hole remained permanently and permitted ample room for drainage in case of reinfection.

Necrosis is rarely found in the maxillary sinus, but when present it is no contraindiction to the intranasal operation. I have found necrosis of the lateral nasal wall present in two cases, and have also noted it around the root of a diseased tooth which penetrated the antrum. If the diseased tooth has not been removed previous to the operation, it should be extracted at once and the root canal curetted. In such cases the operation can be made more radical by the removal of as much bone as is deemed necessary by the operator.

It seems unnecessary to report the details of each of the forty cases operated by this method, but with your permission I will read the histories of a few typical ones:

Case 1.—Mr. J. E. B.: When first seen on April 24, 1918, he complained of having had a foul discharge from both sides of his nose for several years. Transillumination gave a bilateral shadow. Pus was flowing from both middle meati in abundance. Bilateral ethmoid disease was evidenced by polypi in the middle meati. Irrigation of the antra through natural opening showed a large amount of free pus present, pea soup in character. Daily irrigation for two months did not diminish the amount nor change the character of the pus. On June 28th the left antrum was opened by the method described. A good view of the cavity was obtained and found to be practically filled with polypoid growths. These were removed with the curette and forceps, and the cavity packed

with xeroform gauze. The ethmoids were exenterated on both sides. The right antrum was not operated at this time. Cultures of pus from the left antrum showed staphylococci, streptococci, and a gram negative bacillus resembling the bacillus mucosus. Three weeks later, at which time the left, or first operated side had entirely cleared up, the right antrum was opened by the same procedure. Polypi also filled this cavity. On the third day the patient left the hospital. He was seen every day for one week; granulations were controlled with trichloracetic acid, but the antrum was irrigated only on alternate days. The discharge was scanty and mucoid in character. During the second week the sinus was irrigated twice, and during the third week once, but there was no sign of any discharge at these times. He had perfect healing in two weeks and was completely cured in twenty-one days. I have seen him at intervals since then, and there has been no recurrence of the antrum or ethmoid infection.

Case 2.—Miss B. S.: Age 31 years. When first seen on August 19, 1918, complained of pain in left side of face and a foul nasal discharge and tenderness in the region of the left maxillary sinus. Three weeks previously the left antrum had been operated upon through the canine fossa, but this opening had not entirely closed. Repeated irrigation of the sinus resulted in no improvement. The discharge was putrid and pea soup in character. On September 9, 1918, the antrum was opened in the manner above described. A large mass which filled the cavity was removed and proved to be a strip of gauze about one yard long which had inadvertently been left in the antrum at the previous operation. Bacteriologic examination showed a predominance of streptococci and a few colonies of staphylococci. The granulations were curetted and a sequestrum found at the site of the opening, originally made through the alveolar process, was removed. The patient then made an uneventful recovery within twenty-one days.

Case 3.—Miss S. St. A.: Age 21 years. Was first examined March 9, 1918, and gave a history of recurrent pain over the right maxillary sinus together with purulent discharge from the right nares. On March 21, 1918, the right antrum was operated by the procedure employed in our other cases. This was one of the cases in which the electrically driven trephine

was used. Although suppuration in this instance had been a very profuse one, the patient rapidly made a complete recovery. When last examined about two years after the operation, the antrum was found perfectly dry.

SUMMARY OF THE ADVANTAGES OF THIS PROCEDURE.

1. Operation is performed under local anesthesia with little reaction.
2. Operation may be radical or conservative, as judged by the pathologic condition at the time of operation.
3. A view of the antrum cavity is secured and may be maintained during after-treatment.
4. No oral incision is necessary.
5. No suturing is needed.
6. A fairly simple form of antrum operation with all the results obtained by any of the other methods.

BIBLIOGRAPHY.

Canfield, R. B.: Tr. Am. Laryngol., Rhin. and Otol. Soc., 1907: pp. 384-393.
Watson-Williams: Jour. Laryng., London, 1914, XXIV, p. 113.
McKenzie, D.: Proc. Roy. Soc. Med., London, 1912, VI, Laryngol., Section 9.
Sturman (Berlin): Archiv. f. Laryngologie, XXIII, p. 143.
Deuber: Med. Bl., Wien, 1907, XXX, p. 601.
Andrews: Journal of Ophth. and Otolaryngology, Chicago, 1914, VIII, p. 185.
Sluder: Weekly Bull. of St. Louis Med. Soc., 1909, III, p. 461.
Denker: Jour. Laryngol., London, 1910, XXV, p. 420.

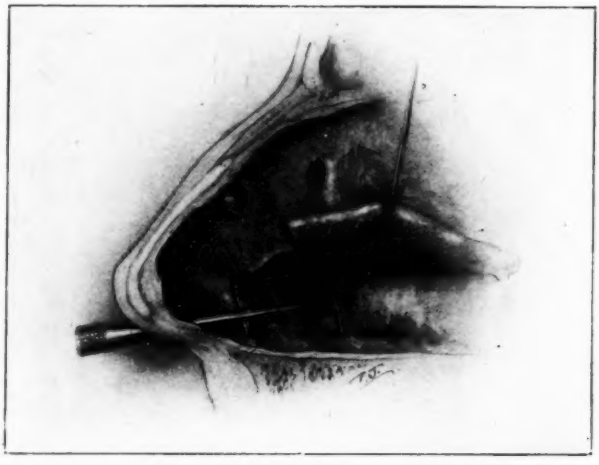


Fig. 1. Infracted turbinate showing initial incision through mucous membrane. Pyriform crest illustrated by dotted line.

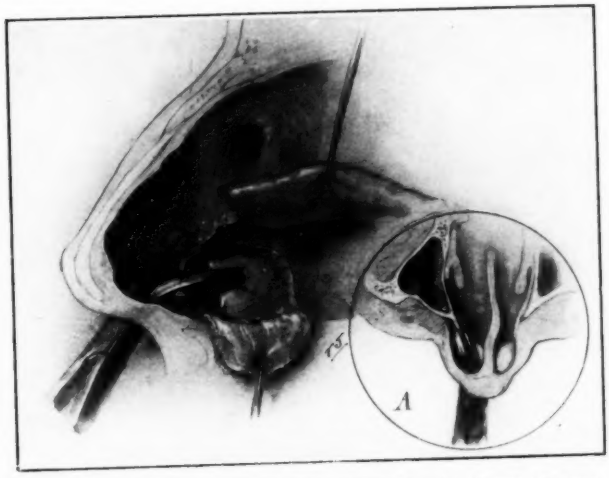


Fig. 2. Mucous membrane flap retracted. A—bone forceps in position.

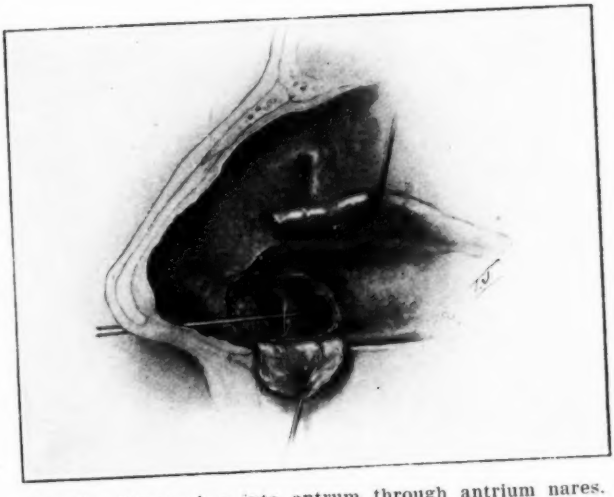


Fig. 3. Direct view into antrum through antrium nares.

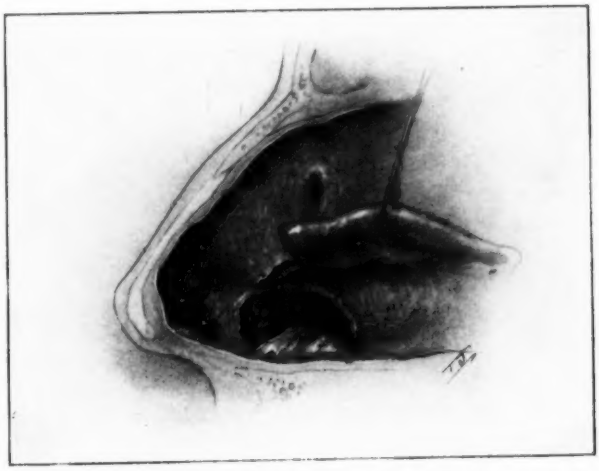


Fig. 4. Flap of mucous membrane in place; ready for packing.

V.

SUBMUCOUS REPLACEMENT FOR EXTERNAL DEVIATION.*

DR. T. E. OERTEL, M. D.,

AUGUSTA, GA.

It is with some degree of hesitancy that I come before this body to present for its consideration the procedure about to be described.

Perhaps it is seldom that any operator follows absolutely the textbook technic of an operation. More usually he fits the operation to the needs of the case and thus literally "makes the punishment fit the crime," or he may even habitually vary the operation in minor details to conform to his own notions. Such variations should not be warrant for imposing on his suffering fellows a lengthy dissertation heralding a new operation. As I have only made some minor modifications in the submucous operation, perhaps I fall within the above category. In addition to this, the cases in which I have employed the technic have not numbered more than a dozen, nor was it possible to follow these up for any considerable length of time.

Also some of them were failures. In spite of all this, I have ventured to risk taxing your patience; perhaps even my failures may be of some service in preventing their repetition by another.

The submucous resection of the nasal septum is one of the most satisfactory operations that has been devised. In any form of deviation which begins well within the vestibule one has but to have a care that the mucous membrane is preserved and that the deviating bone and cartilage is sufficiently removed to allow the two walls to fall together in the median

*Read before the American Laryngological, Rhinological and Otological Society, Boston, Mass., June 3rd, 1920.

line and form a straight partition where formerly there was a crooked one. But when, in addition to a posterior deflection the tip of the triangular cartilage is distorted and out of place, we are confronted by another and more difficult problem.

Removal of the entire cartilage results in a straight septum but a flabby one. All authors caution against removing too much of this structure on account of the deformity that will result. If, coupled with an anterior deformity of the septum there is a deviation of the external parts, the situation is still more complex.

During my service at Camp Logan I was consulted by a number of soldiers in which both conditions were present. There was obstruction to respiration on account of a deflection of the septum involving the tip of the triangular cartilage, and there was a marked deviation of the external nose.

The usual operation fails to provide for such a condition. In some of the cases the tip of the cartilage was not only displaced but was bent upon itself so that it was cupped. All of the cases gave a history of trauma. I regert that I have no more accurate records than the casts which our dentists were good enough to make for me, as these do not show the true relations, there being always more or less flattening of the tip due to pressure of the plaster. We had no means of securing photographs. I have made two models of the septum to represent the two most common forms of deviation with which I had to deal.

These models are, of course, not exact reproductions, but they will serve to show the type of deflection in which the operation may be of benefit.

In casting about for some means of reducing both the internal and external deflection it occurred to me that it might be possible to use some form of splint between the mucous surfaces—in other words, to replace the crooked cartilage and bone with some substance which would help hold the parts in proper relation and at the same time act as a support to the bridge of the nose as well as the tip and so avoid the flabby tuberosity which is an unpleasant end result. Thin plates

of celluloid were used for this purpose in five cases. All of them had to be removed. Either there was infection or the irritation was so great that it was deemed best to extract them. The longest time that one was in place was three weeks. In this case there was no pus present, but the mucous membrane was swollen and thickened to several times its normal diameter, and nasal baerthing was impossible. The only service the splint rendered was in retaining the replaced tip in its proper situation. This it did, and in so far the result was good. After the failure of the celluloid splints was demonstrated I employed in several cases a splint from the perpendicular plate of the ethmoid. This was taken as the last step of the operation and served admirably, as in no case was there reaction or suppuration. Of course this result is what one would expect in an autogenous graft.

The only difficulty experienced was in obtaining a piece of bone long enough to meet the indications.

With care this may be done, as in the anterior deflections the perpendicular plate is usually little changed except at its more anterior part. Here it is often thick and spongy, and so much of it must be cut off with the biting forceps and discarded, the splint being taken from the thin portion remaining. It was found possible thus to secure a piece large enough to serve to hold in place the parts at the tip after mobilization by incisions as indicated in the individual case.

OPERATION.

The site of the incision must depend upon the character of the deflection. Where there is a pronounced angle the cut should be made through the mucous membrane and perichondrium along the crest of this angle and well into the underlying cartilage. The deflections of this nature are always due to trauma, and the cartilage will be found to have been broken and bent upon itself at the crest of the ridge.

Usually this point is well within the vestibule. The incision, therefore, will be at least fifteen millimeters posterior to the tip of the cartilage, and it should extend from the top of the ridge along its edge to the floor of the nose, where this is possible.

The mucous membrane and perichondrium are now elevated toward the tip, so as to form a pocket in this direction and give free access to the underlying cartilage. This is accomplished with a narrow elevator, the tip of which is bent upon itself. Having nothing better at hand, I made one from a spoon handle. Fig. 1.

The mucous membrane on the opposite side being very thin, it is safer to separate the cartilage by the use of a dull elevator following the line of primary incision. This is usually easy if the original cut has been made deep enough.

The cartilage of the tip is now freed at its base, either with a knife or by elevating it from the bone with a dull dissector. It now swings free, being only attached above and to the mucous membrane of the opposite side.

The next step is to elevate the mucous membrane at both sides as in the ordinary operation and to remove the cartilage and bone posteriorly as far as may be demanded.

The mucous membrane having been elevated to the junction of the nasal bones with the cartilages, an angular knife is employed to sever the connection of these structures. External force with the finger completes the section.

The nose is now freely movable from this point forward and may be placed in the median line.

If the cartilage left at the tip is cupped it must be freely incised in such directions as to flatten it. This is accomplished by the use of a small knife with the shank bent upon itself in order to permit of its use in the anterior pocket of mucous membrane, as with a knife of the usual form it is not possible to reach this area. I devised two such knives with which cuts may be made in any direction desired, the blades being short in order that the cut may extend only through the cartilage and not wound the mucous membrane of the opposite side.

The knives are crude, as I had only two broken tonsil knives from which to fashion them, and my only tools were pliers and a three cornered file, and my forge an ordinary spirit lamp. Fig. 1.

The strip of bone from the perpendicular plate of the ethmoid is now secured and placed alongside the mobilized cartilage of the tip in the pocket of mucous membrane extending back along the line of the septum between the two mucous surfaces. The primary incision is closed with two sutures of black silk and a light pack of borated vaselin gauze placed in the size of the incision. Another useful dressing in all forms of this operation is made by packing into a rubber finger cot a thin strip of gauze with an ordinary packing instrument. The outer end is tied with a string and cut off close to the nose. To remove the pack the end is cut off, the gauze extracted and the finger cot slips out easily without giving pain to the patient or causing hemorrhage which so often follows removal of any other form of dressing.

To hold the external nose in place I have used various methods with more or less success.

That which gave the best result was dental modeling material. This is placed in hot water until pliable and moulded to fit the nose and face, a good bearing being secured on each side to avoid pressure upon the nose. After it has hardened it may be fastened with adhesive strips and should remain in place for several days.

It is best to overcorrect slightly the deviation, as there is always a tendency towards resumption of the original position. A copper splint would doubtless serve the same purpose, and has the advantage of lightness, which the dental composition has not. If, however, it is rolled out thin, not more than an eighth of an inch in thickness, it is well borne.

One must here, as in many other instances, "follow the nose." I believe the operation to be of service in the special forms of deflection for which it was devised, and it may also serve in those cases where there is a pronounced deflection of the tip of the triangular cartilage without external deviation, as a more stable tip is secured by it than if the cartilage is removed.

It would seem that in any event a replacement of structures out of place is better than a removal of them. This has been recognized by operators who have replaced the piece of cartilage removed with the Ballenger knife in the usual operation.

By this means the normal thickness of the septum is preserved. I considered using cartilage thus removed as the splint for the tip, but rejected the idea for the reason that it would be less stable than the bone and would be more bulky and narrow the vestibule.

A thin piece of rib might be employed, but this entails the rather serious operation for its removal.

FIGURE 1.

FIGURE 2.

FIGURE 3.

VI.

A CASE OF A FOREIGN BODY IN THE ESOPHAGUS REMOVED BY EXTERNAL ESOPHAGOTOMY; CURE.*

By J. N. Roy, M. D.,

PHYSICIAN TO THE HÔTEL-DIEU, MONTREAL; LAUREATE OF THE ACADEMY OF MEDICINE OF FRANCE.

The case of a child, four years of age, having had in his esophagus, for nearly fourteen months, a foreign body which had become wedged there by one of its sharp points, and which had resisted two attempts at removal by the ordinary direct methods, presents, it seems to me, a subject sufficiently interesting to justify the following observation:

Case Report.—On April 10, 1919, H. S., four years of age, was brought to the Hôtel-Dieu Hospital, suffering with a foreign body which had lodged in the child's esophagus. The mother stated that on March 4, 1918, her child swallowed an iron washer, and as he complained of a pain in the throat, his grandmother, in attempting to remove the cause of the trouble, put her finger into the child's mouth and only succeeded in pushing this foreign body further down.

The patient's breathing continued to be normal.

The following days the child was able to swallow liquids and semiliquids, but solid food was rejected. A physician who was consulted prescribed a purgative.

During the ensuing nine months nothing special was noted in the condition of the boy, except a little constipation and a growing difficulty in swallowing. The patient never complained of pain.

Towards the end of December a medical student, relative of the family, insisted that a serious examination should be made of the child, in a hospital, and it was brought to Montreal.

---

*Read before the Canadian Medical Association, Quebec, June, 1919.

The consulting surgeon requested an examination with X-rays, and by this means the foreign body was located above the clavicules. After having administered chloroform the surgeon introduced the Kirmisson hook into the esophagus, but as all attempts at extraction were fruitless, he declared that the instrument did not even touch the foreign body.

In the presence of this failure esophagoscopy was advised. However, as New Year's Day was approaching, the mother decided to take the child back home, promising to return later. In the interval there is nothing particular to note.

On April 10th, the child began to swallow liquids with difficulty, and he was brought to the Hôtel-Dieu Hospital, where I saw him for the first time. A second radiograph, taken the previous day, showed that the foreign body was still in the clavicular region. I proposed that an esophagoscopic examination should be made, and this being accepted it was done the next morning.

Chloroform was administered and the tube was easily passed down the throat to the affected region. At that point I came in contact with an accumulation of granular tissue which commenced to bleed at the least contact.

A few touches of adrenalin diminished the hemorrhage. These granulations were so numerous that it was impossible to see the foreign body. As the wall of the esophageal canal, which had been in contact with the iron washer for more than thirteen months, seemed to be very diseased, I did not judge it proper to clean it. A pair of forceps was introduced into the tube, and by slight movements, feeling my way as it were, I was able to touch the foreign body which was lodged there. It was then not difficult to take a firm grip of it, and I slowly withdrew the esophagoscope and the forceps. After having displaced the washer and moved it over a short distance, it became wedged again, and offered marked resistance to all further efforts at removal. In order to avoid tearing the esophagus, already badly diseased, I decided to make no further attempts, and withdrew the instruments.

The child's mother was then informed of the exact situation, and external esophagotomy was proposed and accepted. However, for reasons which could not be controlled, the operation was not performed until April 24th.

There is nothing special to be noted during the intervening period.

Operation.—The patient was again put under chloroform, and his head, held in extension by means of a bolster placed under his shoulders, was slightly turned to the right. On account of the well known anatomic fact that the esophagus extends a little on the left aspect of the trachea, I operated on that side, and by the lateral way, which is the most rational. The incision practiced on the inward edge of the sternocleidomastoid, went from the sternum to the cricoid cartilage. The vascular nervous bundle was exposed and drawn out by means of a retractor. By dissecting deeply I came across the omohyoid muscle and slightly raised it. The left lobe of the thyroid gland was not in the way. In order to facilitate the finding of the esophagus, the caliber of which was rather small, seeing the tender age of the little patient, a bougie was introduced into the mouth and gently passed down the esophagus. After having found the recurrent laryngeal, I made, behind that nerve, an incision of about 22 mm. and opened the esophagus near its posterior aspect. The bougie being removed, the foreign body was sought at the spot located by the X-rays. I could plainly see the granulations which bled at the slightest contact, even with the use of adrenalin, but I could not find anything more. The left index finger was then inserted in the esophagus through the vertical incision, and it immediately felt the iron washer which was pushed back into the mouth, to be seized and removed with the right hand. After disinfection of the hands, I inserted into the left nostril, for feeding purposes, a Nelaton tube which reached to the stomach and which was firmly attached to the back of the head with a point of support at the ears. Contrary to the views of a majority of surgeons, whose counsel is not to suture the esophageal wound but to let it heal of granulation, I preferred to close it with a continuous suture of catgut, after making sure that the place corresponding with the incision was not diseased. To this suture, I added three deep stitches to support the esophagus, in isolating the recurrent laryngeal nerve, and I closed the wound with silkworm gut, after having placed a drain at the point of greatest declivity. Slightly compressive dressing.

As a matter of prudence, I bound the hands of the little patient.

The foreign body measured 23 mm. in diameter and weighed 5 grams. It was not symmetrically round, and at the point where it was soldered there was a cavity whose edges were bound by a sharp point, about which I shall have more to say later on.

The outcome of this operation, which I succeeded in performing entirely with a knife, and without applying a ligature to any of the blood vessels, was very successful. The child was nourished on liquids by the Nelaton tube, and was kept in bed in a horizontal position. The first dressing, changed at the end of forty-eight hours, was hardly soiled. However, during the following days, the secretion came a little more abundant and thick from the esophageal wound. There was never any fever, and by the beginning of the second week the secretion had diminished, and I removed the drain. As during two days it seemed to be thoroughly drained, the nasal probe was withdrawn in its turn, two weeks after the operation. There remained now only to heal but a small superficial wound corresponding to the place where the drain was. The dressings were accordingly continued until June 3rd, when the child was completely cured and was able to return to his home. He now eats solid food without the slightest difficulty.

In a previous article* I have had occasion to discuss at some length the diseases of the esophagus and their treatment, so that I need not say anything further on this subject at present. I shall merely be satisfied with drawing attention to the interesting points which are contained in this observation. It is well known that the mortality, as the result of external esophagotomy, is very high, and it has gone beyond 40 per cent when intervention has been delayed for a long time after the accident.

The age of the little patient in the present case is the first thing that is striking—he was only four years old—and next is the fact that the foreign body he had swallowed had been in the esophagus for nearly fourteen months.

*J. N. Roy.—De la nécessité de l'oesophagoscopie pour le diagnostic et le traitement des affections de l'oesophage. L'Union Médicale du Canada, février, 1919.

The uncontrolled attempts made by the surgeon to extract the washer with a Kirmisson hook, while being imprudent, might have become disastrous, for, handled a little roughly, that instrument would have perforated the esophageal wall and caused a secondary suppurative mediastinitis.

In making the esophagoscopy, I did not at first wish to remove the granular tissue, in order to enable me to see the foreign body, for fear of increasing the existing injuries, and after having taken hold of the washer and moved it on a course of about 4 cm., the movement was arrested as soon as I felt it was again wedged. This wedging was easily explained when I came to examine the points of the iron washer, and its condition made it manifest that I surely would have torn the esophagus had I persisted in my efforts to extract the body.

The technic employed in this external esophagotomy followed very closely that recommended by the majority of authors, and if in this instance I have achieved success I attribute it:

1. To the great care I have exercised in my dissection;

2. To the very small incision made in the esophageal wall and to its immediate closing;

3. And finally, to the Nelaton tube passed through the nostril, which permitted me to feed the patient in reducing to a minimum the dangers of infection from the cervical wound and its possible complications.

VII.

BORDERLINE DISEASES OF THE ESOPHAGUS.*

By Henry Lowndes Lynah, M. D.,

New York City.

For diagnosis and treatment of the diseases of the esophagus, the use of the esophagoscope, which enables one to study and treat the field seen by its aid, is undoubtedly a great advance in this line of work.

In the writer's opinion, it will be only a matter of a short time when all of the other methods of treatment applied to diseases of the esophagus in the dark, so to speak, will be superseded by esophagoscopy.

The chief symptom for which patients come to seek relief is difficulty in swallowing. This may be brought about by a spasm or a mechanical obstruction.

Spasm.—Normal spasm of the esophagus is a condition producing a temporary stenosis at the upper and lower ends, the cricopharyngeus and the hiatal opening of the diaphragm. This is present in all cases examined esophagoscopically without anesthesia. When this normal spasm becomes excessively irritable it is then termed esophagismus. It would, however, be well to call it a neurotic esophagismus, for it is most often encountered in neurotic subjects. Many of these patients suffer from some thyroid derangement and are extremely nervous. They also complain of a constant lump in their throat and come into the office labeled hysteria. The socalled "globus hystericus" from which patients complain of a feeling of a lump in the throat is due to this neurotic spasm element which is frequently associated with difficulty in swallowing. An ulceration may be present in some of the cases, but usually the esophagus is found to be contracted but otherwise normal. Air swallowing is a frequent accompaniment in this type of patient and they belch large quantities of gas. They also complain that certain kinds of food taken aggravate their condi-

*Read as part of a symposium on borderline diseases before the annual meeting of the American Laryngological, Rhinological and Otological Society, Boston, Mass., June 2-4, 1920.

tion. They recite the foods which they cannot swallow and rebel against making any attempt to even try to swallow them. They are pale and anemic, and look half starved.

A patient referred by Dr. Joseph Abraham, who had been unable to swallow for a long time on account of a persistent lump in her throat, complained that she had difficulty in swallowing at certain intervals during the day, and also that she could never swallow cake without great difficulty. She was, however, able to swallow cereals and eat bread, but with each attempt to eat cake it would stick in her throat and she would have a violent choking spell, as she described it. She had been examined by two neurologists, who pronounced her a typical case of hysteria with marked "globus hystericus." Bougies had been introduced blindly and two attempts were made to pass the esophagoscope before admission to the hospital, but were unsuccessful. The patient had a complete set of radiographic plates with her, which showed only the thoracic esophagus which appeared normal. Unfortunately, the pictures were taken not sufficiently high to show the trouble, which was in the cervical esophagus, involving the cricopharyngeus constrictor. A new set of plates made of the cervical esophagus by Dr. Charles Gottleib showed a very definite contraction which looked not unlike an esophageal stricture.

The writer has esophagoscoped several of these subjects. Some of them were apparently cured after the introduction of the esophagoscope without anesthesia. Three of the cases, however, were not cured and only temporarily relieved after the introduction of the esophagoscope, and another required esophageal dilatation at intervals for two years before she could swallow all foods with ease. The case cited had difficulty in swallowing cake, even after the large adult esophagoscope could be introduced with ease, and after ten treatments. As afore stated, spasm of the cricopharyngeus always occurs on the introduction of the esophagoscope without anesthesia, but this can be readily overcome by gentle lifting of the cricoid cartilage. However, on the other hand, there may be a marked spasticity of the cricopharyngeus in patients suffering from malignant disease of the esophagus, even when the malignancy is well below the cricopharyngeus constrictor or even at the cardiac orifice.

Spasm of the Hiatus.—The degree of contraction of the normal hiatal orifice of the esophagus is nothing in comparison to the contraction of the pharyngeus constrictor on the introduction of the tube. In the spastic stenosis at this level we all must admit that Jackson is correct in his assertion that the spasm commences at the hiatus, for such is certainly the case when viewed through the large esophagoscope. However, on the other hand, in all cases of hiatal esophagismus there is seen radiographically some of the bismuth mixture trickling through the hiatal constrictor and abdominal esophagus as a thin streak, to suddenly open as a large mass as the bismuth or barium mixture enters the stomach. While there is difficulty in observing under ocular guidance the relative amount of contraction of the abdominal esophagus and the cardia, at the same time radiographic studies seem to show that there is a complete contraction, or better, a cardio-narrowing from the entrance of the esophagus into the diaphragm to its exit at the cardiac orifice of the stomach. Jackson believes that a spasm of the cardia alone is extremely rare. He quotes Liebault and Roget on their anatomic studies that the hiatal orifice in the diaphragm is the chief factor in the production of the socalled cardiospasm. Mosher, on the other hand, in exhaustive anatomic studies of the esophagus and who knows more about the anatomy of the esophagus than any living man today, still maintains that there is a definite sphincter action of the cardia owing to demonstrable circular muscular fibers which promote a sphincter like action. The writer feels that both Jackson and Mosher are correct. The former having made all of his observations under direct ocular guidance, while Mosher, a finished anatomist, has been able to prove his findings, both by ocular guidance and extensive anatomic studies. The writer not being an anatomist and having a limited experience in this field, can only rely on visual studies and agrees with Jackson that the first definite contraction encountered is at the narrow slit like opening in the esophagus known as the hiatus. It must not be forgotten, however, that a carcinoma of the cardiac end of the esophagus may give all of the symptoms of hiatal esophagismus, cardiospasm or cardiocontraction. Cardiocontraction or cardionarrowing is certainly what is encountered, and I doubt if the

spasticity is solely confined to the hiatus alone. From radiographic studies the subphrenic portion contributes to the entire contraction.

To distinguish cardioesophagismus from malignant disease of the esophagus is one of the borderline problems in diagnosis. The differential diagnosis is best accomplished by means of ocular guidance, gastric analysis and a careful study of the symptomatology and the radiographic plates.

Cicatricial Stenosis of the Esophagus.—The most frequent source of cicatricial stenosis is in the swallowing of caustic alkalies. When there is a history of a child having drunk from a cup which was used for some washing powder, and is admitted to the hospital in profound shock and suffering from acute esophagitis, it is best to wait until the acute symptoms have subsided before bouginage is attempted. Gastrostomy should be performed early as soon as it is definitely shown that the child is suffering from water and food starvation. For a long time it has interested the writer as to the final locality of the cicatricial stenosis after the subsidence of the acute attack. Guisez states that the most frequent site of the resultant stricture is at the cardia. Jackson differs with him and states that the stricture may occur in any portion of the esophagus, and that he has never seen a stricture at the cardia. In seven cases studied by the writer in children, the stenosis was at the upper orifice in three and below the bronchial crossing in all of the others. In adults the strictures encountered were usually high, but one occurred in the middle third of the esophagus. Why is it that the diluted corrosive has a predilection for attacking one portion of the mucous membrane and not the entire esophagus as in strong solutions, such as carbolic acid and ammonia, etc.? Is it because the child has been a previous sufferer from chronic esophagitis, or is it due to an anatomic peculiarity of the esophageal mucosa which is more susceptible to ulceration than other parts? It would seem that the strictures should occur at the narrowest portion and that part susceptible to narrowing, but such is not the case.

The borderline conditions resembling stricture of the esophagus in children other than impactions of food and foreign bodies resulting in strictures, are comparatively few. On the

other hand, in adults there may be a good history of having accidentally swallowed some caustic alkali in childhood for which they were never treated, and have been able to swallow fairly well until recently when there had been much difficulty in swallowing. When such a case presents itself, it should be studied with great care, both fluoroscopically and radiographically, before esophagoscopy is attempted. Esophagoscopy should then be performed with great care, bearing in mind that the stricture shown in the radiographic plate may be due to a stenotic web or a malignant growth at the site of the former ulceration. Bouginage should be practiced with great care; for if it prove to be a stenosis due to malignancy the esophagus may be ruptured in the attempt to relieve the condition.

A case of this type was referred to the writer with a history of having swallowed accidentally some caustic alkali in childhood. He had never been examined, though at times he had some difficulty in swallowing. He also gave a history of having been a constant sufferer from indigestion, heartburn and belching of gas. These were looked upon by the family doctor as being more or less due to nervousness. Radiographic plates showed a narrowing in the region of the hiatus and cardia. By esophagoscopy the esophagus was found to be normal down to the hiatus and no stricture could be seen. At the hiatus there was a small mass of fungating tissue which was resistant and bled easily. A section taken showed it to be an epithelioma. Gastrostomy was performed two days later and revealed the mass involving the whole of the cardia. Whether this had been the previous site of the original caustic stricture I was unable to state. However, the contraction at the hiatus was much more resistant than a malignant stricture usually is, and no doubt the resultant ulcerative cicatrix had been the starting point for the development of the cancer.

As a rule the endoscopic picture of a cicatricial stricture is readily recognized. Cicatricial strictures usually present a whitish appearance with surrounding normal mucosa. The difference between an esophageal stricture due to a cicatrix and a neoplasm, is that the former is very firm and the surrounding esophagus does not give as it does in a malignant stricture. A cicatrix is very firm to the touch and the open-

ing often very difficult to locate, while the malignant stricture is seldom impermeable, unless the mass has been ingrafted on a cicatricial stenosis. The cancerous mass is usually fungating and readily recognized. However, there may be a cicatricial ulceration at the site of the malignancy, and both may be present and cause complete stenosis.

Paralysis.—When there is a paralysis of the esophagus, there usually are found palsies existing in other localities. They most frequently follow the acute infectious diseases, such as diphtheria, poliomyelitis, etc. Difficulty in swallowing may occur early or late in these diseases. Sensory paralysis of the larynx as well frequently accompanies this. Often in these patients direct laryngoscopy and bronchoscopy can be performed without discomfort to the patient, for they complain of no sensation and are apparently cocainized. The writer called attention to this loss of sensation a few years ago in a treatise on diphtheria. In examining these patients with a mirror retention of secretion is seen in both pyriform sinuses. The sinuses gradually fill to overflowing, and as the secretion cannot flow into the esophagus it trickles over between the arytenoid cartilages and flows downward into the lungs. If there is complete loss of sensation and the cough reflex is impaired, these patients are unable to cough up the secretion and the lung becomes "sponge soaked," and they succumb to a terminal pneumonia. Bronchoscopic evacuation will, of course, relieve the condition, but this cannot be kept up indefinitely and the patient should be placed in a position to establish postural drainage. The best way to overcome this pouring of secretion into the lung is to insert a rubber intubation tube into the esophagus so that the secretion can flow into the esophagus and allow the lungs to act.

Case Report.—A very interesting example of what I supposed to be a bulbar paralysis came under my observation. Mrs. J. S., an old lady of seventy-two years, had a slight stroke of paralysis with involvement of the facial muscles two years previously. At that time she had a very high blood pressure, but this had fallen and she had gradually regained her health. She had been able to eat breakfast and luncheon with ease on the day of the second stroke, but when she sat down to eat dinner she was unable to swallow. She stated

that she felt peculiar before dinner, and when she sat at the table and attempted to eat she was unable to do so. She then drank some water and had a violent choking spell. I saw her the same evening with Dr. Theodore H. Allen, who gave me the foregoing history. On indirect inspection the larynx was seen to be normal. The vocal cords moved freely; there was no loss of sensation at this time in the pharynx or larynx. The pyriform sinuses were filled with secretion which would pour over between the mouthlike arytenoids into the larynx. With inspiration the excessive tenacious salivary secretion would flow in and then there would be a violent coughing spell, and at this time she had some difficulty in getting it out. There was no loss of voice or impairment of speech. She was put in postural drainage which greatly improved the condition. Her blood pressure at this time Dr. Allen reported as being high, but not as high as it had been during her slight paralytic stroke two years previously. There was slight drooping of the corner of her mouth on the right side, but no other paralysis could be noted. The tongue protruded straight and there was no loss of sensory reflex or cough reflex. The following day she was admitted to St. Luke's Hospital and esophagoscoped. Before esophagoscopy was performed Dr. Le Wald gave her some bismuth subcarbonate in an aqueous solution to swallow to see if there had been any relaxation of the cricopharyngeus constrictor at the upper end of the esophagus. Watching her through the fluoroscope a teaspoonful of bismuth mixture was given, and it promptly trickled downward, but too far forward to be in the esophagus. We watched it carefully, and when it reached the bifurcation of the trachea it made a turn to the left and entered the left main bronchus and passed downward to the lower lobe branches. Having had previous experience with the injection of bismuth mixtures into the bronchi of the living, we felt that the mixture would do no harm. While she had an irritable cough the day previously when secretion trickled into the trachea and bronchi, there was noted at this time that there was no attempt to cough as the bismuth mixture entered the tracheobronchial tree. The cough reflex was lost. It is extremely interesting to note that the bismuth mixture was spat up by the patient and the lung drained of the bismuth mixture even without any

sign of an expulsive cough. Of course some of it came from the reservoirs of the pyriform sinuses, but the lung was drained of the mixture before the cough reflex returned. The patient was esophagoscoped. There was a marked spasticity of the cricopharyngeus such as I had never encountered before on the introduction of the esophagoscope without anesthesia. This certainly was not a case of cricoesophagismus with which we had to deal, for the patient was not of the hysterical type and had never complained of her throat before. After the introduction of the esophagoscope and its passage through the cricopharyngeus the esophagus was found to be relaxed, but otherwise normal. On gently removing the tube the lip was violently grasped as it started to emerge through the cricopharyngeus. The esophagoscope was again pushed down and the spasm once more relaxed. Again this was tried with the same result. Finally, a stomach tube was introduced through the esophagoscope and the instrument withdrawn. The patient was fed in this manner and by having the tube in the esophagus the normal secretions were able to leak past the constriction. The trachea and larynx were covered with the bismuth mixture. The bismuth was coming out while she was in the recumbent position, but she had made little effort to cough. Bronchoscopy was not performed. The patient was fed by the stomach tube for more than six weeks before she was again able to swallow normally. In the meantime Dr. Allen had reduced her blood pressure, and I am happy to state that at the present time she is in good health.

This extremely interesting case was at first glance taken to be one of hysterical spastic esophagitis, but on further study it proved to be due to some involvement of the glossopharyngeal nerve supply, and therefore should be classified as a peculiar type of bulbar paralysis caused by a central lesion.

Another extremley interesting case I had the good fortune to see with Dr. F. J. Bevan. This young lady of twenty-two years had been in fairly good health, but was anemic and lacked outdoor life, being confined to an office all day. One evening on returning from work she had some difficulty in swallowing her dinner and choked several times. She was put to bed and the family physician notified. On his arrival at the home he found her very hysterical and attributed her

general rundown state and poor general health as the probable cause of the condition. After a small dose of morphia the patient quieted down and seemed to be improved. A further test to swallow, however, proved unsuccessful. I saw the patient the same evening. At this time there was ptosis of the left eye and a divergent squint. The pupil was widely dilated and she complained of seeing double.

She also had difficulty with respiration but was able to speak. She complained of pain in the region of her heart. The larynx was examined with a mirror and the vocal cords were found in good working order. There was no paralysis to be seen and they moved freely. Both pyriform sinuses were filled with secretion which would pour over into the larynx. The cough reflex was partially lost and with each endeavor to expel the secretion the sound produced was similar to the paralytic nasal grunting cough so often heard in diphtheritic paralysis. Later there was complete loss of sensation. The patient's difficulty in breathing was due to phrenic paralysis. The diaphragm did not move with inspiration and the epigastrium remained flat. An esophageal spatula was rapidly introduced and a rubber feeding tube inserted. A diagnosis of polioencephalomyelitis was made and the spinal cord tapped. Dr. Edward D. Fisher, the neurologist who was called to see the patient, did not arrive in time to find her alive. The temperature remained normal throughout the attack which covered a period of fifteen hours from the time I saw her.

Pouches.—Diverticula of the esophagus are classified into two groups according to their etiology: Traction diverticula and pulsion diverticula. Traction diverticula are extremely rare conditions. Jackson has reported one case. Arrowsmith had a very remarkable case of this type which the writer had the privilege of assisting him with at the esophagoscopic examination. Arrowsmith's case seemed to be a combination of a traction and a pulsion diverticulum. As a rule, the traction diverticula are seldom seen, as they are small and readily overlooked. They usually open upwards so that the bismuth mixture does not enter them. This was what Arrowsmith demonstrated in his case. The traction and pulsion diverticulum occurred in a patient suffering from pulmonary tuberculosis, who also had tuberculosis of the esophagus. There

were more fungations in the esophagus which looked not unlike malignancy. The case was diagnosed by Arrowsmith from the radiographic plate and demonstrated by Mosher's ballooning esophagoscope.

Pulsion diverticula are hernial sacs which most frequently occur in the cervical esophagus. They may have a sudden onset, especially in the aged, after an attack of coughing, and produce marked dysphagia and simulate paralysis in the suddenness of the attack. Usually, however, they come on more slowly, and may give no symptoms and are only found on the introduction of the esophagoscope. This occurs when they are extremely small.

Killian was first to recognize the anatomic weak point in the production of diverticula of the cervical esophagus. The etiology of the adherent traction type has already been mentioned.

At times there may be a cicatricial stenosis of the subdiverticula orifice and also the subdiverticula esophagus, especially in large pouches which continually cause pressure by overdistention with food. In one of the writer's cases there was a complete cicatricial stenosis of the whole of the subdiverticula portion of the esophagus and the man was suffering from starvation. Gastrostomy was performed by Dr. Bodine, but unfortunately the patient did not survive. In another case there was a malignancy of the upper esophagus which simulated a pulsion diverticulum.

In a third case in an old lady of seventy-eight years the onset of the diverticulum was extremely sudden. She had never had difficulty in swallowing that she could recall. She contracted a severe cold, and it was after an attack of violent coughing that she first noticed that she was unable to swallow. The family physician was notified and pronounced the difficulty to be due to a paralysis on account of her age, high blood pressure and suddenness of the attack. No one thought of having an esophageal examination and no radiographic plates were made. She continued to suffer in this condition for seven years. She was referred to the writer on account of such difficulty in swallowing that she was beginning to suffer from starvation. By mirror inspection the larynx was seen to be normal. The pyriform sinuses were filled with secre-

tion. An esophageal pouch was suspected from the history, which was confirmed by radiographic plates made by Dr. Charles Gottleib. Dr. Gottleib reported as follows: "There is a diverticula present in the cervical esophagus about twice the size of a hen's egg. There is a small trickle of bismuth to the left of the pouch which passes down through the subdiverticula esophagus."

The patient was prepared for esophagoscopy. The laryngeal speculum was introduced, for from the radiographic plates the opening into the subdiverticula esophagus was extremely high. The laryngeal spatula was introduced its full length and search made on the left side for the orifice. By pulling the cricoid cartilage well forward I noticed a small dark spot on the anterolateral wall. A small bougie was readily inserted and passed through into the stomach. A 7 mm. esophagoscope was now introduced, using the bougie as a guide, but it would not enter the lumen of subdiverticula esophagus. Then a series of bougies were introduced and the orifice dilated. There was a cicatricial fold hanging over the slit of the esophageal opening. This pouch seemed to spring from the esophagus very high up, and in fact the whole of the pharynx seemed to be included in the pouch and continuous with it. After sufficient dilatation was accomplished the patient was able to swallow better. The writer had Mosher's operation in view after he had sufficiently dilated the subdiverticula esophagus.

The writer also had in mind the dangers of opening into the mediastinum. With a long pair of alligator forceps one blade was introduced into the subdiverticula esophagus and the other blade into the pouch. By this means the common wall was held firmly in between the blades of the forceps and squeezed together. The purpose of this procedure was to set up adhesions between the wall of the pouch and the esophageal wall and shut off the mediastinum before cutting the common wall, and thereby lessening danger of mediastinal infection. Perhaps this is not at all necessary, for Mosher in his series of cases does not mention clamping the common wall before cutting, and so far by opening directly into the mediastinum he has had no bad results. Perhaps these adhesions which I was trying to produce by the clamping method before cutting are already present. To the writer's great surprise the squeez-

ing together of the subdiverticula wall and the pouch wall made the subdiverticula opening into the esophagus increase in size and the patient has been able to swallow much more comfortably ever since. She swallows semisolid food and even solid food when it is finely cut.

So far the writer has not cut the common wall, but he feels at this time that it is a perfectly safe procedure, and the danger of mediastinitis produced by cutting the common wall would be averted.

This method of treatment seems applicable to diverticula in the aged. It relieves their suffering; adds only a minimum amount of danger, and effects a cure as far as their condition is concerned.

In younger subjects the resection operation performed by the surgeon seems to give the best results and permanent relief. A very unique operation was devised for this purpose by Gaub and Jackson, when the external operation was performed in such cases. It consisted of the esophagoscopist introducing the esophagoscope as a guide so that the redundant pouch would be removed and not the lumen of the esophagus which would result in a stricture or contraction later. This operation may be performed in one stage; but it seems best to perform all operations which are apt to involve the mediastinum in two stages to avoid fatal mediastinitis. Cryle is an advocate of the two stage operation for esophageal diverticula, and had recorded by this method gratifying results. In the cutting of the common wall, as advised by Mosher, the writer has attempted to make this a two stage operation by clamping the two sides of the common wall together to produce adhesions before any attempt is made to sever it. It was also found that by carrying out this procedure the opening into the subdiverticula esophagus may be kept open and allow sufficient food to pass. Of course a stricture of this subdiverticular portion of the esophagus must necessarily be dilated before any operation is attempted. Many of these patients refuse operations—that is, major operations proposed for relief; but on the other hand the two cases that the writer has treated by dilatation and fusing of the common wall have had relief and have improved in health.

Malignant Disease of the Esophagus.—Many cases suffering from malignant disease of the esophagus may have borderline relations to neurotic esophagismus and be mistaken for "pure neurotics," and treated as such.

In one of the writer's cases a woman of sixty-two years had been treated by six different specialists for different conditions, and after twelve months referred to the writer as a case of probable foreign body in the bronchus. All of them, however, agreed that she was suffering from some neurosis which was producing the symptoms. The history of difficulty in swallowing and constantly choking on taking food or water pointed strongly to esophageal obstruction.

On indirect examination there was seen a paralysis of the left vocal cord. Both pyriform sinuses were filled with secretion which would pour over into the larynx and produce the cough. After having seen the paralyzed left cord I naturally suspected a large aneurism to be at the bottom of the trouble, but such had not been reported by any of the physicians. On swallowing the bismuth mixture, there was plainly seen fluoroscopically a stenosis of the thoracic portion of the esophagus about the bronchial crossing. Radiographs showed no aneurism present. The following day the patient was esophagoscoped and an ulcerative fungating mass was seen and recognized as malignant. A section was taken and examined by Dr. J. G. Callison, who reported it to be an epithelioma. Gastrostomy was advised but the family refused permission. They did not object to having her treated by the tubes. Radium was applied and she was able to swallow better for one week. Then she started to completely close, so much so that a 4 mm. soft rubber intubation tube was introduced. The patient was now able to swallow liquids and was greatly encouraged. An esophageal tube may be left in for one week and then changed and cleansed and reintroduced. As a rule the smallest intubation tube has to be discontinued in time, for the malignancy as it increases will gradually close the lumen and the size of the tube used will have to be smaller and smaller until it cannot be introduced at all.

It is not difficult to introduce an esophageal intubation tube. The esophageal spatula is best for introduction and the tube is introduced through or along the side of the spatula.

Esophageal intubation has prolonged the lives of three hopeless cases of esophageal malignancy, and gastrostomy was performed just prior to the time of demise.

In removing an esophageal intubation tube the same rule applies as in removing a tube from the larynx or a tracheal cannula. There must be in readiness another tube which is immediately reintroduced, for contraction of the esophagus within a short time will render reintubation impossible. The writer has had palliative success with soft rubber esophageal intubation tubes. The writer has also made applications of radium to the esophageal lesion, but aside from the slight improvement in swallowing, there is little gained over esophageal intubation. In one instance the esophagus perforated after radium and the patient succumbed to bronchopneumonia. This, however, is frequently the termination of most of the cancerous growths of the esophagus of long duration. So far little has been accomplished by any form of treatment in esophageal cancer and the endoscopic treatment is in most cases purely palliative. Of the surgical procedure the transthoracic method as advised by Willy Meyer, Frans Torek, and others, seems to be on the road to success in cases diagnosed esophagoscopically early. Frans Torek has one case on whom he operated for a malignancy of the esophagus in the middle third who made a complete recovery and is still alive and well after seven years.

Luetic Stenosis of the Esophagus.—Luetic stenosis of the esophagus may be associated with luetic disease of the larynx. It may occur in the form of a mucous patch, an ulcer, a gumma or a cicatrix. The writer has studied two cases of luetic disease of the esophagus. One was in a man suffering from a gumma of the larynx as well, and the other was in a woman with cicatricial stenosis. The man was unable to swallow and was extremely dyspneic. He was sent to the hospital with the diagnosis of laryngeal diphtheria. Tracheotomy was performed shortly after admission to save his life. He was still unable to swallow after the introduction of the tracheotomy tube and the esophagus was examined and found to be gummatous. A soft rubber feeding tube was introduced and the patient fed in this manner. Mercury and salvarsan were administer after the Wassermann reaction

returned 4 plus. He readily improved under treatment and was able to swallow fairly well two weeks later. An examination of the esophagus after two months' treatment showed a cicatricial web stenosis of the upper esophagus. The larynx greatly improved, but it was impossible to decannulate the patient, for he preferred to wear the tube. He had a husky voice. He insisted on leaving the hospital three months later and was transferred to the Metropolitan Hospital and lost sight of thereafter. At the time of discharge from the hospital he still had laryngeal stenosis, and a cicatricial esophageal web.

Tuberculosis of the Esophagus.—The writer has seen many cases of laryngeal tuberculosis who were also suffering from esophageal involvement. He feels that much of the difficulty in swallowing in laryngeal tuberculosis is often due to involvement of the esophagus as well. Esophageal ulcers may often be present in tuberculous subjects when the lesion is not suspected, but only seen when performing the esophagoscopy. At times there may be a tubercular lesion of the esophagus which looks not unlike a fungating epithelioma. These healed lesions at times may produce cicatrices and subsequent stenosis.

There are many other lesions of the esophagus which the writer in a rather limited experienec has not been so fortunate to see. They are angioneuritic edema, esophageal varix, angioma and actinomycosis.

Fig. 1. Neurotic cricopharyngeal spasm. Note the narrow constriction of the bismuth mixture in the cervical esophagus. Cured after repeated introduction of the large esophagoscope.

Fig. 2. Cardiocontraction and narrowing of the abdominal esophagus in a boy of twelve years. The whole of the subphrenic portion of the esophagus shows narrowing and demonstrates that the whole of the subdiaphragmatic esophagus contributes in the production of so-called cardiospasm.

Fig. 3. Hiatal esophagismus or cardiocontraction in an adult. There is marked dilatation of the thoracic esophagus above the diaphragm.

Fig. 1. Stricture of the cervical esophagus simulating neurotic cricopharyngeal spasm. The stricture was caused by the prolonged sojourn of a small spicule of bone following a submucous resection of the septum.

Fig. 5. Paralysis of the esophagus. The bismuth mixture was held in the reservoirs of the pyriform sinuses and poured over between the arytenoids into the larynx, trachea and bronchi. The bismuth in this instance entered the left bronchus and not the right. There was no cough reflex. It was expectorated and the lung drained of bismuth without the aid of cough.

Fig. 6. Esophageal pouch in a woman of seventy-nine years. The pouch involved the entire pharynx. There was partial stenosis of the sub-diverticula esophagus.

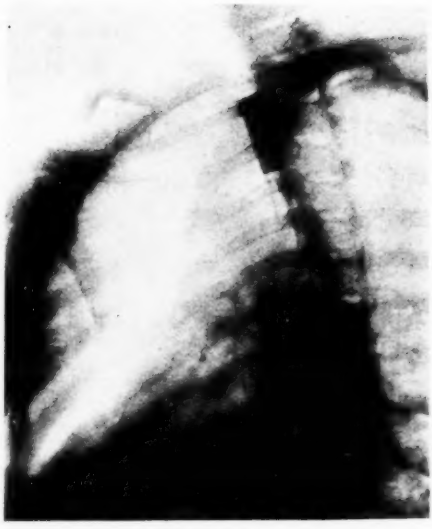


Fig. 7a. Malignant stenosis of the thoracic esophagus. The short silver intubation is covered with soft rubber and is shown as two long lines below the end of the metal tube.

Fig. 7b. Radiograph of same patient showing the bismuth mixture passing through the tube.

VIII.

THE REMOVAL OF TONSILS IN THE PRESENCE OF A PERITONSILLAR ABSCESS.

By J. Holinger, M. D.,

Chicago.

The removal of tonsils while a peritonsillar abscess is present is not approved by physicians generally and is practiced by few. Cates in his article in the Laryngoscope of October, 1918, says: "And H. A. Barnes recommends tonsillectomy for the cure of quinsy during the attack. However, such radical forms of treatment have not received much favor as yet, not being in accord with generally accepted surgical principles." Cates does not say with which generally accepted surgical principle this procedure was not in accord, and evidently he has never tried the method himself. The objections against the procedure may concern either the clinical or the pathologic phase. Clinically, or rather clinico-historically, we may say that formerly when only parts of the tonsils were removed, the procedure may have led to sepsis, because it often did not drain all pockets of the abscess. Now with the systematic and total extirpation of the tonsil, we see the opposite. Patients who arrive in a septic condition on account of peritonsillar abscess with high fever, dry tongue, etc., make a completely different impression a few hours after the tonsils have been removed, and the writer in a comparatively large number of operations has never seen a case of sepsis following or continuing beyond the removal of the tonsils.

On the other hand, the advantages of the procedure overbalance by far all possible real or imaginary objections. We mention only a few:

1. We know that peritonsillar abscesses often recur. Therefore, sooner or later the tonsils have to be removed if the recurrences are to be prevented. Why make two operations for what can be done in one?

2. The period of recovery after the removal of tonsils in

the presence of a peritonsillar abscess is not longer than after the removal of tonsils without abscess.

3. In peritonsillar abscesses often new abscesses are formed next to the old ones. In one patient we had to open a second, a third and a fourth abscess after the first one was drained. The duration of healing was six weeks. Now the matter is much simpler. After the tonsil is out, all these pockets are drained and heal, as said before, in the same time as the wound after a simple tonsillectomy.

4. Patients who were in a decidedly septic condition are relieved of their sepsis soon after the tonsils are removed. The pains in different parts of the body subside, and it happened repeatedly that considerable quantities of albumin which were found in the urine before the operation disappeared completely within the next few days after the removal.

Pathology: The lymphatic tissue of the tonsil is arranged in a network of connective tissue which forms its support. This connective tissue on the outside becomes the capsule of the tonsil and is in connection with the connective tissue of the surrounding organs, muscles and facias. It contains the blood vessels, lymph vessels and nerves. Inflammations and especially the formation of abscesses follow the connective tissue and leave the parenchyma comparatively free. In a few cases the abscess following and spreading in the capsule practically dissected the tonsil. As soon as the upper pole of the tonsil was loosened from the palate and the pus removed, the tonsil was found to be quite loose in its niche, so that it had only to be freed from the pillars. These were the true peritonsillar abscesses. Several times a second and a third gush of pus appeared during the dissection and showed that multilocular abscesses are not so very rare. They sometimes extend high up into the palate; sometimes they spread between the muscles of the surroundings of the tonsils. This explains the stiffness and the painful mobility of the head and neck which we usually notice in patients with peritonsillar abscesses. This also explains why the walls of the abscess are not always smooth but often irregular. Several times we found that the abscess was not peritonsillar but an intratonsillar abscess spreading in the connective tissue of the tonsil itself. The tonsil in one of those cases was cut or divided into several different parts. At least, this is the only way

findings like the following could be explained. In dissecting the upper pole no abscess was found in the swollen and bulging soft palate. The upper pole reached far up into the soft palate, and the pus was met only in the middle or even below the middle of the tonsil. A compact or coherent mass of tonsillar tissue could not be found below the middle of the tonsil. The walls of the abscess cavity were irregular. As much of the scattered tissue as could be found was removed together with the upper pole of the tonsil. From the scattered remnants a large part of the tonsil formed again during the period of recovery. This was the only not quite satisfactory result that we have to report. It must, however, be added that the patient was unreasonable in that he smoked incessantly, even during the first days after operation.

The operation of removing the tonsils in the presence of a peritonsillar abscess has several unusual features which we will try to point out under different headings.

1. The anesthesia is general ether narcosis. In one case local cocain adrenalin anesthesia was tried, at the urgent request of the patient, but in the inflamed tissue it was very unsatisfactory to both patient and operator. The experiment will not be repeated. The ether narcosis, however, requires considerable care and experience, since often the swollen side of the pharynx and soft palate fills a large part of the pharynx and makes breathing difficult. Consequently there is often more than the usual amount of resistance till the patient is asleep. The suffocation sometimes reached very high degrees, but we never had to resort to tracheotomy or intubation. During the state of excitement the abscess broke in one case. It is a good plan to draw the attention of the anesthetist to such a possibility, that the pus may be removed before it is aspirated or swallowed.

2. At the operation the parts are often found very much distorted and the line of cleavage of the pillars is not always seen at first sight. As soon as the knife follows it, a gush of pus pours into the pharynx and is aspirated by means of the suction apparatus. Quick action is necessary, and it is evident that well trained assistants for the narcosis as well as for the operation are desirable. As soon as the pus is removed there is much more room in the pharynx. In remov-

ing the tonsil care has to be taken that no cast off lobe of the tonsil is overlooked. All the tissues are very brittle.

3. The hemorrhage is often greater than in a simple tonsillectomy. It is diffuse, but also the spurters have more caliber than under ordinary circumstances. The bleeding usually stops on compression with dry gauze or with gauze soaked in peroxide. The removal of the second tonsil is usually much easier and simpler. The after-treatment is not different from that after an ordinary tonsillectomy. A gargle of two tablespoonsful of peroxid in one glass of water will do as well as anything.

Barnes in 1915 recommended removal of tonsils during an attack of quinsy only in favorable conditions—i. e., in small abscesses. We have operated for more than seven years and have not made any distinction in small or large abscesses. We have used ether narcosis. We, too, hesitated in the beginning, but have never seen any bad results.

The following report may be of interest:

A strong young man of 19 had had several attacks of tonsillitis before. July 12, 1920, started with sore throat. July 18, was examined. The mouth could not be closed because the tongue, especially in the base, was swollen and painful. Outside under the chin, the floor of the mouth and the sides of the jaws were bulging and very painful to touch. The glands, too, were swollen. In depressing the tongue a peritonsillar abscess was recognized. July 19th, both tonsils were removed; in the left one an abscess was met with. The swelling of the tongue improved within the next five days.

IX.

REPORT OF CASES. 1. SIMPLE MASTOIDECTOMY ON MAN, 81 YEARS OLD. 2. INFECTIVE SIGMOID SINUS THROMBOSIS — A POSITIVE BLOOD CULTURE WITH STREPTOCOCCUS MUCOSUS CAPSULATUS PRESENT.

By J. Warren White, M. D.,

Norfolk, Va.

Case 1.—In September, 1917, I was called out of the city to see Mr. A. in consultation.

He gave a history of pain in his right ear for two weeks. On examination I found tenderness over the mastoid on pressure. The drum was very red and bulging.

A free myringotomy was done and he was removed to the Norfolk Protestant Hospital for observation. There was a profuse purulent discharge from the ear and the pain gradually became worse. On the fourth day after seeing him I decided to operate. On account of his age and general condition I attempted to operate under local anesthetic. Being unable to get any cooperation from my patient, I found it impossible, so a simple mastoidectomy was performed under ether anesthesia.

The mastoid cells were found to be pretty thoroughly destroyed. Dura was exposed in the operation.

One week after the operation he developed an infection in the left ear. A free myringotomy was done.

He made an uneventful recovery. He is living today and is enjoying comparatively good health.

Case 2.—I did a simple mastoidectomy on M. T., 10 years old, at St. Vincent's Hospital.

There was nothing unusual about the case. A culture from the mastoid showed streptococcus mucosus capsulatus. Sinus and dura were both exposed in the operation.

The child did well, and after the first week the temperature became normal and remained so until the twelfth day. On the night of the twelfth day after the operation she had a severe chill, with a rise of temperature to 105° F. The next day her temperature returned to normal. The pulse rate was 150 beats per minute, and she was completely prostrated. During the day she had another chill, with a rise of temperature to 105° F.

She was taken to the operating room. The mastoid wound was opened and the sinus freely exposed. The jugular vein was ligated and then the sinus was opened.

The report from the blood culture was positive, with streptococcus mucosus capsulatus present.

After a long illness she finally recovered.

X.

ENCEPHALITIS LETHARGICA AS A POSTOPERATIVE COMPLICATION OF ACUTE MASTOIDITIS WITH REPORT OF A CASE.

By M. J. Siegelstein, M. D.,
New York.

The pathologic data of this form of intracranial lesion are exceeding meager, and though the records show many cases which have completely recovered following middle ear suppuration, these cases were diagnosed from their clinical findings only; and as positive diagnosis is almost impossible, the findings at operation deliver the only data to the actual conditions present in a given case, and it is with such intentions that I report the following:

Mr. O., age 37, had an attack of influenza in March, 1919, which lasted three weeks. At the end of the third week he began to have pain in the right ear with fever. Paracentesis was done, and the pain and fever relieved; the discharge from the ear was profuse and thick.

About a week later, when the discharge had almost disappeared, he began to have fever and seveer pain over the right side of the head, with rigidity of the back of the neck and twitches on the right side of the face, a temperature of 103 and pulse 120.

He was then referred to me by his physician, Dr. Bookstaber, for operation. Mastoidectomy was performed on the same day with the result that as soon as the cortex of the mastoid was removed thick white pus began to well up, and this furnished an easy guide to the antrum, which was high up under the zygomatic ridge. The antrum and cells were thoroughly cleared out down to the mastoid tip.

On the following day the temperature came down to normal and the patient remained well until the fourth day after operation, when his condition began to change and he complained of a severe diffuse headache and dizziness, and he did not sleep that night; temperature 100.

At 5 o'clock the next morning he had slight delirium, and it was with difficulty that he was restrained from getting out of bed. A few hours afterwards he began to get drowsy; temperature varied from 99 to 100; pulse, 74 to 80; conplained of general weakness as well as diplopia; answered questions slowly and incoherently; slight twitchings of face with felt facial palsy noticed. No evidence of labyrinth involvement.

He remained in stupor the entire day and had to be awakened to take nourishment, and this somnolence deepened the next day, so that he could only with difficulty be aroused, relapsing, however, into the same previous condition. Temperature 102; pulse 80 to 96. I then decided to explore the cranial cavity.

Examination revealed heart and lungs normal; no discharge from the ear or mastoid wound; accessory sinuses negative; pupils regular, dilated, reacting to light; eyegrounds normal; no local tenderness; urine negative; no Kernig, Babinski or other abnormal reflexes present; swallowing difficult; sensation markedly impaired; blood examination—white cells 12,000, polynuclears 80 per cent; Wassermann negative; spinal fluid showed moderate pressure in the recumbent position; cell count normal; globulin negative; no bacterial growth; smear negative; Wassermann negative.

Accordingly, on the night of the sixth day following operation, the mastoid wound was again opened for revision to see if any carious bone or fistulæ were overlooked, and as it was clean, the wound was extended upwards above the zygoma for two inches, and then a horizontal incision was made from the center of the original one back to the occipital protuberance.

The bone was ronguered upwards through the zygomatic process and through the squama, starting from the tegmen antri, exposing the dura over the right temporosphenoidal lobe of the cerebrum for an area of 2 by 2 inches.

No extradural exudate was found, dura appeared to bulge, pulsated and was normal, and there was no tension of fluid between it and the cerebrum, after it was incised. Examination of the cortex showed the brain swollen and edematous, with diffuse hemorrhagic areas throughout the field.

Exploration of the temporosphenoidal lobe in various directions was done both by means of a long aspirating needle, as well as by a long narrow pointed knife for a depth of about two inches, and no abscess was discovered, but the lateral ventricle was opened, with clear fluid oozing out and not under marked tension. Working back from the lateral sinus, which was normal, the cerebellar lobe was exposed, and exploration here also proved to be negative. Dura was left unsutured for its decompressive effect and patient was returned to bed without any shock.

He reacted well and the next morning was able to open his eyes and look around him, although he still was stuporous. On arousing him, only indistinct mutterings were heard and he immediately went back to sleep.

The day following, somnolence was still present, and during the afternoon he had an attack of pulmonary edema which lasted about one hour and disappeared, leaving his lungs clear, but in a few hours the coma deepened, with Cheyne-Stokes respirations, and he made his exitus.

Autopsy in this case was unfortunately not obtained because of family objections.

Remarks.—In this case the difficulty of arriving at a differential diagnosis was obvious, and resort to exploration to give the patient the benefit of the doubt was indicated.

Brain tumor was excluded by the absence of changes in the eyegrounds as well as the presence of fever.

Meningitis (serous, suppurative, tubercular and syphilitic) were excluded by lumbar puncture, examination of spinal fluid and the exploration.

Abscesses (extradural, cerebral and cerebellar) were excluded by the exploration; sinus thrombosis by history and examination of sinus at operation.

The presence of cortical hemorrhagic areas with swollen and edematous brain substance noticed in the operative field is characteristic of encephalitis and the clinical history confirms the findings.

The onset of the encephalitis during the convalescence of the mastoid operation is confusing, when the more common complications, as abscesses, meningitis and sinus infection, are ordinarily looked for.

Körner from the report of those cases supposed to have recovered believed that the eradication of the primary lesion in the temporal bone was sufficient, or in addition the free exposure of the affected area will often result in a cure and that ventricular and lumbar puncture would help combat the disease. There is no doubt that those cases that have recovered would have recovered without operation, as attested to by the many reports now published, and that those who died could not have been benefited by operation. Operation is only indicated in those cases complicating mastoid operations where the exploration will exclude other complications requiring surgical treatment.

REFERENCES.

Skversky: Lethargic Encephalitis, Am. Journ. Med. Sc., December, 1919.
Kopetzky: Surgery of the Ear.
Dench: Diseases of Ear.
British Med. Journ., February, 1919.
Wien. Klin. Wochenschr., May, 1917.
Paris Med., August, 1918.
Journ. Am. Med. Assn., January, 1919.
Journ. Am. Med. Assn., March, 1919.
Korner: Die otitische erkrankung des Hirns, 1902.

XI.

TONSILLAR HEMORRHAGE.*

By T. E. Fuller, M. D.,

Texarkana, Ark.

The factors which influence postoperative tonsillar hemorrhage are so varied that accurate statistics are difficult to obtain. In 700 consecutive cases in children in Barnes' service at the Boston Dispensary only two hemorrhages occurred that required suturing the pillars. In 140 tonsillectomies on patients over 16 years of age at the Massachusetts General Hospital there were four hemorrhages that required suturing of the faucial pillars.

The replies to a questionnaire sent out by L. G. Hill indicate that troublesome hemorrhages range from ½ to 8 per cent, the majority being from 2 to 5 per cent. Troublesome hemorrhages are 4 per cent greater in adults than in children.

Relative to dangerous hemorrhages, 10 per cent of the replies were zero, the balance ranging from 1 to 6 per cent. One prominent operator reported twelve cases of fatal hemorrhage, one reported four cases, one reported three cases, four reported two cases and others reported none. It is interesting to note that out of the 14,042 tonsillectomies done in our army there was only one death from tonsillar hemorrhage.

As to whether the number of hemorrhages was greater following local or general anesthesia, the majority stated that the percentage was greater under general. About 30 per cent, however, stated that the hemorrhage under local anesthesia was higher. Many of them accounted for this fact by the large number of adults operated upon by this method. The report of the Committee on Local Anesthetics read before the section on laryngology, rhinology and otology of the American Medical Association at New Orleans indicates that the percentage of hemorrhages, when local anesthesia is used, is not greater.

*Accepted as a candidate's thesis by the American Laryngological, Rhinological and Otological Society.

The above figures confirm what one from his own experience and observations knows to be true, namely, that everyone who performs the operation of tonsillectomy will sooner or later encounter hemorrhages, some of which may be severe enough to tax his skill to the utmost, and yet when we consider the methods of hemostasis used by many operators and note those advocated in certain textbooks and journals, we wonder if the reproach that the control of hemorrhage, during and following tonsillectomy, is most inexact and unsurgical, is altogether unmerited.

The tonsil receives its blood supply from the dorsalis linguæ, a branch of the lingual, which supplies the anterior pillar and sends branches into the anterior surface of the gland. From the ascending pharyngeal of the external carotid branches enter from the posterior pillar. The descending palatine from the internal maxillary sends a branch to the superior lobe. The most important arteries are the tonsillar and ascending palatine branches of the facial. These pierce the superior constrictor muscle at the lower pole of the tonsil, where they usually break up into two or more branches before entering the capsule. The arrangement of these branches is variable. Davis observes that they are most commonly found just behind and about one-quarter of an inch from the margin of the anterior faucial pillar, about midway between the top and base of the tonsil, or a little below this point. It is said that occasionally by anastomosis of the above named vessels an arterial plexus is formed just outside the capsule. The writer has not observed such an arrangement. The internal carotid artery is almost an inch behind and to the outer side of the tonsil. The external carotid is still further away, and is protected by the styloglossus and stylopharyngeus muscles. It will thus be seen that the carotids, when normally placed, are in very little danger of being wounded during a tonsil operation. Dr. Gwilym G. Davis has demonstrated a specimen in which the internal carotid could have been wounded by incision of the tonsil.

The facial artery when it makes a high loop before crossing the ramus of the jaw has only the superior constrictor muscle between it and the lower pole of the tonsil. The ascending pharyngeal and ascending palatine arteries are also

separated from the tonsil by the thickness of the superior constrictor muscle alone. When very firm peritonsillar adhesions exist it is possible to wound one of the three last named vessels and have a fatal hemorrhage. As the ascending palatine frequently takes its origin from the external carotid instead of the facial, it would seem more certain to ligate the external carotid and not the facial in cases of serious tonsillar bleeding.

The ligature on the external carotid should be placed as low as possible in order to control the ascending pharyngeal, which arises close to or immediately at the origin of the external carotid. The veins terminate in the tonsillar plexus which joins the pharyngeal and pterygoid plexuses to empty into the internal jugular or facial vein. Some small veins empty into the larger vessels at the base of the tongue. A large vein frequently runs the length of the tonsillar fossa just external to the posterior pillar. When wounded, it bleeds profusely. The writer has seen one troublesome postoperative hemorrhage from this vessel.

The successful arrest of hemorrhage depends on the clotting power of the blood. No doubt the statement of Bayliss, who writes "It cannot be said that the coagulation of the blood is yet understood," is correct; nevertheless, the theories of Howell are the most generally accepted, and as the action of a number of hemostatic agents is best explained by his researches, brief reference to them will be made.

When blood clots, the circulating fibrinogen of the serum is transformed into an insoluble protein fibrin by the action of fibrin ferment or thrombin. Thrombin, as such, does not exist in the blood, but its precursor, prothrombin, does, and this is converted into thrombin. In order that this change may take place calcium salts are necessary; also an element derived from the blood platelets, or injured tissue, or from both, called by Howell "thromboplastin." Blood does not coagulate in the vessels, because this prothrombin is combined wtih an antithrombin, which prevents it from acting. When the blood is shed and flows over injured tissue, the thromboplastin, derived from the blood cells, blood platelets or tissue cells, unites with the antithrombin, liberating the prothrombin. This in turn combines with calcium salts, and thrombin is formed. The thrombin converts the fibrinogen of the plasma

into fibrin and coagulation sets in. It has been shown that thromboplastin, from whatever source, gives the reaction of lipoid kephalin, the principal lipoid of the brain. This fact has been taken advantage of in the preparation of many substances used to hasten coagulation. The recent work of Mills indicates that extracts from lung tissue are even more active than those of brain tissue in inducing coagulation.

The part taken by the platelets in the process of clotting has been further studied by Tait, who believes that when a vessel is cut the labile platelets, or spindle cells, called thigmocytes, adhere to the edges of the vessel wall and build up a plug. By cytolysis these same cells produce the thrombin which causes the plasma to clot, thus taking two distinct parts in the checking of hemorrhage.

Types of Hemorrhage.—The types of hemorrhage encountered in tonsil cases are:

Primary, which occurs at the time of operation;

Early secondary, which comes on in a few hours, and is frequently the continuation of a primary hemorrhage which was not checked, and

Late secondary, which most frequently occurs at the end of four or five days or a week. As a rule it is not serious, being produced by the opening up of small vessels during the separation of the slough.

Predisposing Causes.—The conditions which render troublesome bleeding more likely to occur are certain blood dyscrasias, such as hemophilia and the purpuras, high blood pressure, arteriosclerosis, acute inflammation of the tonsils or surrounding structures and peritonsillar adhesions. Anemic and poorly nourished children have a tendency to bleed.

It is said that during and immediately following the menstrual period the clotting time of the blood is delayed. The exciting cause of tonsillar hemorrhage is, of course, the operation, during which the vessels are severed.

Prophylaxis.—The radical removal of tonsils is an important surgical procedure, and the cases are entitled to a more careful selection than many of them receive. The condition of the heart and kidneys should be ascertained, and in adults the blood pressure taken. Operation should not be done in the presence of acute inflammation of the tonsils or surrounding

structures. The general condition of anemic and poorly nourished children should be improved by the use of proper food and iron tonics. In the case of females the operation should not be done during or for a week following the menstrual period.

Tonsillectomy should always be done in a hospital. If the patient is an adult, he must remain for 24 hours afterward. Children may in some instances be allowed to go out in 12 hours. In taking the case history care should be exercised to learn if any unusual tendency to bleed exists in the patient or his family.

The bleeding and coagulation time should be determined in all doubtful cases. When the coagulation time is delayed and when it cannot be shortened by measures to be discussed later, operation should be refused. In cases where the bleeding time is prolonged, a count of the platelets should be made, and not until their number has been made to approach normal should the tonsils be removed.

Treatment.—No attempt will be made to consider all the measures advised for the control of hemorrhage. Some are uncertain, and others too unsurgical to deserve a permanent place in our armamentarium.

The measures used may be grouped into:

1. Those acting on the blood to influence its clotting, or on the blood vessel walls, or on both.
2. Mechanical measures.

Remedies whose dominant action is to lower blood pressure are not included, because we believe that cases of hypertension should be under the care of an internist, and that he should have lowered the blood pressure, at least temporarily, before operation is attempted.

AGENTS ACTING ON THE BLOOD OR BLOOD VESSELS.

Preparations of the Suprarenal Glands.—Considerable work has been done on these glands ever since the time of Addison, but it was not until 1901 that Takamine succeeded in isolating the active principle in pure and stable form. He gave to the preparation the name of adrenalin. Adrenalin stimulates the sympathetic system in general. When it enters the blood stream it causes elevation of blood pressure and

increased action of the heart. The vasoconstrictor action is peripheral. When applied locally, marked contraction of the arterioles occurs. This is followed by a relaxation of the vessels. Richards and Vosburgh found that adrenalin increased the coagulability of the blood. Wiggins was unable to corroborate these findings. Conman and Gray showed that small doses intravenously and larger amounts subcutaneously shortened the coagulation time one-third or even one-half. Grabfeld finds that the prothrombin is increased by it. When added in small amounts to the solution used to induce local anesthesia, adrenalin is of value. Care must be taken, however, not to have the solutions too strong, or the vasodilatation following its use will render secondary hemorrhage very likely to occur. There is this same objection to its local use following the removal of tonsils. When it is desired to increase the coagulability of the blood there are other substances which are more certain and more desirable. The use of adrenalin then should be limited to the small amount added to the solution to be injected when local anesthesia is used in the removal of tonsils.

Emetin.—Trousseau recommended ipecacuanha as a hemostatic. Its active principle—emetin—has been used for hemorrhages of various kinds since soon after its isolation. Emetin hydrochlorid causes a short rise in blood pressure. Pelline and Wallace obtained no change or only a slight contraction of the arteries. Enous Smith and Middleton found transient vasoconstriction followed by vasodilatation. Howell has noted a deficiency in the fibrinogen in the blood as a result of which the clotting is retarded and the clot not retractile. Bostedo concludes that neither clinical results nor pharmacologic action justify its use in any internal hemorrhage.

Weinstein was the first to report the use of this drug in nasopharyngeal surgery. He found that by injecting emetin he could reduce the coagulation time by one-third. The writer was able to check the bleeding in a case of late secondary hemorrhage following removal of tonsils by the use of emetin. In view of the fact that we have agents more reliable in their action, the use of emetin seems unnecessary.

Pituitary Extract.—The functions of the pituitary gland and the pharmacology of its preparations are still being investi-

gated. It seems from the work done, however, that it may be said that pituitrin constricts the peripheral blood vessels, probably by direct muscular action, and that it slows and strengthens the heart. The coagulation time of the blood is reduced in fifteen minutes after a hypodermic injection, according to Kahn.

This action on the blood is what makes pituitary extracts valuable in the prevention and treatment of tonsillar hemorrhage. Moore finds that given fifteen to thirty minutes before the removal of tonsils it reduces the loss of blood and shortens the coagulation time by one-third or one-half. Salinger reviews 87 cases in which pituitrin was administered as a prophylactic prior to operation, 52 under general and 35 under local anesthesia. In two of the cases there was severe bleeding, the pituitrin apparently exerting no influence. He is convinced, however, that the drug has a marked hemostatic action, as 62 out of the 87 cases showed only slight bleeding which required no pressure or other hemostasis. He concludes from his experience that pituitrin will, in most cases, diminish the amount of blood lost, particularly under general anesthesia, and that for the control of secondary hemorrhage its action is prompt and successful. On the other hand, Donelon's experience leads him to consider pituitrin as uncertain, its chief use being to support the heart and prevent shock.

The writer's experience agrees with that of Salinger. He has used it in a number of cases. While it is not a sure preventive, in most instances it will shorten the coagulation time and lessen the amount of blood lost. Several cases of secondary hemorrhage of moderate degree have been checked by its use alone. The dose is ½ cc. for children; for adults, 1 cc. It should be given one-half hour before the operation.

Calcium Salts.—It was believed that a lack of ionic calcium was the common cause of delayed coagulability of the blood. In order to supply this deficiency calcium lactate or chlorid was given for a variable length of time before operation. In much of the literature on tonsillar hemorrhage these remedies are given a prominent place, but later studies have shown that insufficient calcium is rarely, if ever, the cause of delayed clotting, and further, that it is difficult, if not impossible, to increase the calcium content in the blood by the ingestion of calcium salts.

Rudolf and Cole in 1911 conclude that the exhibition of calcium lactate by the mouth has no appreciable effect on the coagulation of the blood. Van Lier in 1912, after taking the coagulation time in forty persons before and after the administration of calcium lactate, has arrived at the same conclusion. Lee and Vincent draw different conclusions from the above, believing with Wright and Paramore that a distinct difference in the coagulation time can be produced by the injection of calcium. In addition to the above, clinical evidence supports the contention that the calcium salts are not worthy of confidence when it is necessary to shorten the coagulation time of the blood.

Tissue Extracts and Sera.—The knowledge that thromboplastin from whatever source obtained gives the reaction of lipoid kephalin was made use of in the preparation of various substances to increase the coagulability of the blood. The work of Hiss in this field is well known. The substance he prepared came from ox brains. E. R. Squibb and Sons manufacture it and offer it under the name of thromboplastin, which was first given it by Hiss. A thromboplastin solution is prepared by Armour & Company, who also manufacture kephalin, which they describe as "hemostatic phosphotid from spinal cord and brain tissue." Their remedies are in two forms, one for local use and the other for hypodermic administration. The former is used on gauze sponges applied directly to the bleeding area.

It is not expected that this will stop the bleeding from large vessels, but where there is a general oozing or small vessels are involved, the results are very satisfactory. The hypodermic preparation is used in cases of delayed coagulation time.

Coagulen Ciba.—Coagulen Ciba is made solely from the blood platelets. It comes in the form of powder, compressed tablets, and in sterilized ampules. It is used in the same manner as thromboplastin. Bann and de Tarnowsky in this country and many foreign observers testify to the usefulness of coagulen.

Normal Horse Serum.—Normal horse serum and, when it was not obtainable, antitoxin has long been used to check hemorrhage. The results obtained have been variable, and

the danger of anaphylaxis is present. A comparison of the various physiologic hemostatics was made by Hanzlink and Weidenthal. Their results are quoted below:

"From the summary it is seen that the thromboplastins were distinctly superior to all other products tested, the Squibb product possessing a median efficiency of more than three times that of the Armour product, and seven times that of the freshest and some old kephalins."

"The freshest specimens of dry coagulen, coagulen solution in ampules, coagulose and hemostatic serum are seen to occupy the same grouping and efficiency values as normal saline. In other words, these products did not accelerate the coagulation of plasmas and blood in vitro, and accordingly are regarded as entirely inert as thromboplastic agents."

"The freshly obtained and prepared thromboplastic agents which were tested arrange themselves in descending order of the plasma and blood clotting efficiency in vitro, as follows: First, thromboplastin (Squibb); second, thromboplastin (Armour); third, kephalins (fresh and some old specimens); fourth, coagulen, coagulose, hemostatic serum and normal saline."

It would seem that because of its efficiency and because the risk of anaphylaxis is reduced to the minimum, thromboplastin is the remedy of choice when agents of this class are to be used.

Blood Transfusion.—In hemorrhage due to delayed coagulation the best remedy by far is a blood transfusion from a properly grouped donor. In cases where for lack of time or facilities the grouping is not possible, a member of the patient's family should be used as the donor. Some of the agents above enumerated are of great assistance, but their use should be limited to mild cases, or to cases where for some reason a blood transfusion is impossible.

Mechanical Measures.—Pressure, properly applied, will check capillary bleeding and bleeding from small vessels. If kept up for some time hemorrhage from vessels of considerable size can be controlled.

Pressure is made by sponges, held in clamps, or sponge forceps, suturing the pillars with a sponge between them, by the use of pillar compression forceps, such as those of Ber-

geron, and by tonsil hemostats, of which there are many kinds. After the tonsil is removed one or two gauze sponges, held by forceps, should be placed firmly in the fossa for a few moments. This will stop the capillary hemorrhage and the bleeding from the smaller vessels. When these are removed, if one or more vessels bleed, they should be dealt with by other means, and no further time should be consumed in an attempt to check the hemorrhage by pressure.

To suture a sponge between the pillars increases the reaction, is painful to remove and other means are more certain. These same objections apply to the use of tonsil hemostats, and in the writer's opinion they should never be used unless it be to make pressure in the fossa of the first tonsil removed while the second is being operated. To send the patient out of the operating room with one of these hemostats in place or to use one in an attempt to check secondary hemorrhage should not be done.

Ligation of Vessels.—When pressure, as described above, does not control and one or more bleeding points are revealed in the fossa, they should be ligated. Savage of Baltimore says:

"There is no excuse for omitting ligation on account of imaginary difficulties, and resorting to suture of the pillars, or using the clumsy Mikulicz instrument, or mere pressure by gauze sponges until the hemorrhage has apparently ceased to recur after the patient has left the operating table, and then to call it, improperly, secondary hemorrhage."

With this view the writer is in entire accord. Boettcher credits Cohen of Baltimore as being the first to systematically employ ligature of the tonsillar vessels in tonsillectomy. Cohen's method of ligating the vessels is, in the writer's opinion, the simplest and best. It is well illustrated and described in the second volume of Loeb's Surgery of the Nose, Throat and Ear. Other good methods are those described by Parkes and by Gross.

It is necessary to expose the fossa well by the use of a pillar retractor. When a good exposure is obtained, there is, as a rule, little difficulty in placing a ligature around the bleeding point. Occasionally there is too much tissue in the bite of the artery forceps. This will make the pedicle too large and the ligature may slip off. When it is seen that this

is likely to occur, it is well to use a suture ligature. In the placing of these suture ligatures, the writer has found the needle holder of Baum to be the most satisfactory. In cases where it is difficult to grasp the bleeding point, one or two properly applied suture ligatures will control the hemorrhage. There have been a number of special instruments devised to render the placing of ligatures or suture ligatures more simple. Cavanaugh's is one of the best of these.

Instead of using sutures a number of operators employ Michel clips to control the bleeding points. There is no doubt that their use is simple and effective, but one had to be removed from the bronchus of a patient where it had been inspired from the tonsillar fossa. With other reliable means at our command, we should not subject our patients to this additional risk, slight though it be.

Suturing the Faucial Pillars.—Boettcher in the article referred to above states that suturing of the pillars is the most approved, present day method of controlling hemorrhage. If the bleeding vessels are ligated, as a matter of routine, very few cases which require suturing of the pillars will be seen. At times there is a general oozing from the entire bed of the tonsil. Pressure does not control it and individual bleeding points cannot be found. In these cases suture of the pillars must be done. The sutures must be placed in such a way as to include not only the pillars, but the floor of the fossa as well, so when they are tied no dead space will remain.

In this, as in the placing of suture ligatures, the needle holder of Baum has served me well.

In discussing the tonsil question at the meeting of the Southern Section of the American Laryngological, Rhinological and Otological Society, held in New Orleans, in April, 1920, Dr. J. O. McReynolds, of Dallas, Texas, stated that for some time he had been obliterating the tonsillar fossa as a part of every tonsillectomy. He compared this with the closure of wounds made by the general surgeon in other parts of the body. It not only controls hemorrhage, but is an attempt to secure primary union. In the cases where the writer has found it necessary to obliterate the fossa, the stitches have given away in a few days and the same granulating fossa has been left that we are accustomed to see following tonsillectomy.

the only difference being that there was more reaction. For that reason he believes that suture of the pillars should be done only after other measures have failed.

Ligation of the External Carotid.—The writer has not seen a case where it was necessary to ligate any of the vessels in the neck. A number of such cases, however, have been reported, and if all other measures fail one should not hesitate to ligate. Some advise ligation of the facial, and in most cases this would be sufficient, but if it happens to be the ascending palatin that is bleeding and it takes its origin from the external carotid instead of the facial, nothing would be accomplished. For this reason, where it is necessary to ligate a vessel in the neck the external carotid should be selected.

Case No. 1.—A colleague, a general surgeon, removed the tonsils of an eight year old boy, using a Beck instrument. The operation was done early in the morning. At noon the writer was called to the hospital to see the case. The child was expectorating mouthfuls of blood, and showed plainly the effects of acute anemia. The patient was sent to the operating room and gas ether given. A mouth gag was introduced, and by the use of suction and sponges it was seen that the bleeding came from the left tonsillar fossa. This was packed with two or three gauze sponges. By removing these one at a time we were able to locate the bleeding vessel. It was a large vein which ran the entire length of the fossa, just external to the posterior pillar. A section of the vein had been removed about its center, and it was bleeding from both ends. Each end was caught with a clamp, which controlled the hemorrhage perfectly. The surgeon, whose case it was, came in at that time, so the patient was given into his care. He left the clamps on a few hours. When they were removed no further bleeding occurred. The boy made an uninterrupted recovery. In this case I feel certain that the hemorrhage at the time of operation had never been checked.

Case No. 2.—A male, aged 25, was operated upon under local anesthesia. The writer follows the technic of Matthews of Minneapolis. In snaring off the pedicle of the first tonsil two or three wires were broken. The tonsil was unusually fibrous and large. When we came to remove the second tonsil we broke our entire stock of wires and the tonsil was still in

place. The hospital had no wire; the only instrument they had was an old fashioned tonsillotome with a sharp blade. This was used to cut the pedicle. The hemorrhage was slight. The case was watched a few minutes. The anterior pillar was retracted and the fossa inspected. As it seemed to be dry, the patient was sent to his room. About an hour later the interne requested me to come to the hospital, as the patient was bleeding and he was unable to control the hemorrhage. Inspection showed the hemorrhage to be coming from the second tonsillar fossa. A sponge was introduced and held in place. This controlled the hemorrhage. After the sponge was removed the fossa remained dry, so no further measures were necessary. Patient made an uninterrupted recovery.

Case No. 3.—Patient, a female, aged 23, was operated upon under local anesthesia at 8 o'clock in the morning. There was nothing unusual during the operation. The tonsils came out readily and cleanly. The hemorrhage ceased spontaneously. At 9 o'clock that night the nurse asked me to see the patient, stating that she was having some hemorrhage. When seen she was having a moderate hemorrhage, but as it had kept up for some time and pituitrin had no effect on it we felt it unwise to wait longer. Inspection revealed the fact that the bleeding was from the left fossa. It was difficult to locate the exact points. There seemed to be a general oozing. Accordingly catgut sutures, two in number, were taken through the pillars and bed of the fossa. When there were tied the bleeding ceased. At the end of 24 hours the stitches were cut. The patient's recovery was uneventful.

Case No. 4.—Patient, a male, aged 20, were operated on under local anesthesia at 2 p. m. The tonsils were firmly adherent to the surrounding structures and considerable difficulty was encountered in the dissection. They were removed entirely, however, but the fossæ were rather ragged looking. There was a moderate degree of hemorrhage, but it ceased spontaneously, inspection showing dry fossæ. About 6 o'clock the house surgeon reported that the patient was having some hemorrhage, and that he had been given pituitrin hypodermically. This did no good, so normal horse serum was given. An hour later I saw the patient, but the hemorrhage had ceased, so he was not disturbed. Early the next morning I

was requested to see the case, as he had been bleeding some all night. The patient's throat was very sensitive, but we managed to introduce catgut sutures into the pillars on the right side, the one that was bleeding. This, however, did not control the hemorrhage. The patient was anesthetized and the sutures removed. The fossa was again found to be filled with clot from around the edges from which the blood oozed. This clot was thoroughly removed, and as there was a general bleeding from the fossa the pillars were sutured with silk. This controlled the hemorrhage. The patient's recovery was uneventful.

Case No. 5.—Patient, a male, aged 30, was operated on under local anesthesia. The tonsils were easily removed, and the hemorrhage ceased spontaneously. Five days later we were requested to see the case because of hemorrhage. There was a moderate but continuous oozing from under the edges of the slough in the left fossa. Pressure was made with gauze sponges and a hypodermic of emetin given. The hemorrhage was soon controlled and did not recur.

CONCLUSIONS.

1. Everyone who undertakes the operation of tonsillectomy should have in mind definite methods of controlling hemorrhage.

2. Each case should be thoroughly examined. Any tendency to bleed must be overcome by transfusion or injections of thromboplastin or, except in cases of extreme urgency, the operation refused.

3. During tonsillectomy every vessel that bleeds after a moderate amount of pressure has been made should be tied as a matter of routine. In exceptional cases it may be necessary to suture the pillars because of generalized oozing.

4. Postoperative hemorrhage is to be controlled in the same way. The clot must be removed from the fossa. In many instances it is necessary to reanesthetize the patient.

BIBLIOGRAPHY.

Barnes, Harry A.: The Tonsils.

Hill, L. G.: Hemorrhage Following Tonsillectomies. Journal Lancet, Minneapolis, 1919.

Mosher, Harris P.: Observations on Otolaryngology in the War. Annals of Otology, Rhinology and Laryngology, September, 1919.

Wood, George B.: Loeb's Operative Surgery of the Ear, Nose and Throat, Volume 1.

Davis, J. Leslie: Tonsillectomy, Why, When and How. Pennsylvania Medical Journal, November, 1911.

Piersol, George O.: Human Anatomy.

Gray, Henry: Anatomy Descriptive and Surgical, edited by John Chambers Da Costa.

Bayless, Wm. Maddock: Principles of General Physiology.

Howell, Wm. H.: Text Book of Physiology.

Mills, C. A.: The Activity of Lung Extract as Compared to Extracts of Other Tissues in Inducing Coagulation of the Blood. Journal Biological Chemistry, December, 1919.

Tait, J.: Natural Arrest of Hemorrhage From a Wound. Journal of Physiology, September 5th, 1919.

Moore, Irwin: Hemorrhage Following Removal of the Tonsils and Its Treatment. Practitioner, London, 100; pp. 334-361, 1918.

Oppenheimer, Seymour, and Gotlieb, Mark J.: Blood Examinations in the Surgery of the Nose and Throat. The Laryngoscope, July, 1919.

Oppenheimer, Seymour, and Spencer, Henry James: The Value of Laboratory Examinations in Diagnosis and Prognosis in Otolaryngology. Transactions of the American Academy of Ophthalmology and Otolaryngology, 1919.

Bastedo. Walter A.: Materia Medica, Pharmacology and Therapeutics.

Wood, Horatio C.: Therapeutics, Its Principles and Practice.

Weinstein, Joseph: A Clinical Report of the Successful Use of Emetin in the Control of Hemorrhage Following Nasopharyngeal Operations. Medical Record, January 16th, 1915.

Weinstein, Joseph: Nature and Control of Hemorrhage in Nasopharyngeal Operations. The Laryngoscope, March, 1917.

Wiggins, Carl J.: The Physiology of the Pituitary Glands and the Action of Its Extracts. American Journal of Medical Sciences, April, 1911.

Salinger, Samuel: Pituitrin in Tonsillar and Nasal Hemorrhage. Therapeutic Gazette, January 15th, 1918.

Donelon, James: Critical Notes on the Value of Pituitrin Preparations in Reducing Operative or Post-Operative Hemorrhage. Journal of Laryngology, Rhinology and Otology, Vol. 28, p. 353, 1913.

Dennis, W., and Minot, A. S.: Effects of Feeding With Calcium Salts on the Calcium Content of the Blood. Journal Biological Chemistry, March, 1920.

Hiss, A. F.: Thromboplastin (Tissue Extract), as a Hemostatic. Journal of the American Medical Association, April 24th, 1915.

Bonm, H. K.: Further Clinical Studies of Coagulen Ciba (Kocher-Fonio). Indianapolis Medical Journal, March, 1919.

DeTarnowsky, Geo.: Surgery, Gynecology and Obstetrics, May, 1914.

Hanzlink, P. J., and Weidenthal, C. M.: Study of the Coagulation Efficiency of Various Thromboplastic Agents. Journal of Pharmocology and Experimental Therapeutics, October, 1919.

Bergeron, J. Z.: Pillar Compression Forceps for Controlling Hemorrhage Following Tonsillectomy. Journal of the American Medical Association, February, 1916.

Savage, M. M.: Control of Tonsillar Hemorrhage. Journal of the American Medical Association, 53, p. 698, 1909.

Boettcher, Henry R.: Ligature of the Vessels to Arrest Hemorrhage After Tonsillectomy. Illinois Medical Journal, 34, pp. 212-216, 1918.

Parkes, William B.: Control of Hemorrhage in Tonsillectomies. Surgery, Gynecology and Obstetrics, November, 1919.

Gross, William A.: New Forceps for the Control of Hemorrhage After the Removal of Tonsils. Surgery, Gynecology and Obstetrics, March, 1919.

Baum, Harry L.: Complications and Sequelae of Tonsil and Adenoid Operations, Their Prevention and Management. Transactions of the American Academy of Ophthalmology and Otolaryngology, 1918.

Cavanaugh, John A.: A New Instrument for Ligating Bleeding Blood Vessels After the Removal of Tonsils. Journal of the American Medical Association, May 1st, 1920.

Matthews, Justus: Technique of Tonsillectomy. The Journal Lancet, Minneapolis, March 15th, 1917.

XII.

PATHOLOGIC NASAL ACCESSORY SINUSES IN CHILDREN.*

By Francis W. White, M. D.,

New York.

Never before has the adage "The child is father of the man" been brought to the attention of the economist, statesman, publicist, and medical fraternity as it has since a short time after the beginning of the Great War. The slaughter of the physically fit, the biologic crises brought about by the radical changes in dietary due to the blockades and shortage of crops in belligerent countries has brought home the necessity of not only conserving the life of the infant and child, but also the best means of making it possible for them to become 100 per cent men and women, both mentally and physically. The reduction of child mortality is being considered from all angles, as are the best methods, not only of curing ailments of later years, but of preventing them entirely if possible. Every specialty is, so to speak, vying with the other in this respect. To quote Kugelmass,[2] "The time is here, the place everywhere and the obligation everyone's to serve in the cause of national upbuilding through child welfare, for the child is the embryo of the nation's progress, and the parent of the future generation, the potential citizen." From birth to 17 or 18 years of age the human economy undergoes its most rapid growth and physiologic changes, and naturally if predisposing causes for chronic or semichronic diseases or conditions can be eliminated during this period, what a vast amount of good may be accomplished. To do this a coordination of all branches of medicine and science must be consummated. In our particular line of endeavor monumental work had been done in eliminating foci of infection by the removal of the adenoids and tonsils. Are these the only preadult enemies we have to deal with? Are our little adenoid and tonsil patients getting their

*Candidate's thesis, American Laryngological, Rhinological and Otological Society.

full due when these offending members are removed without further endeavor being made to ascertain whether other remaining parts are not potential or undermining factors? In one large special hospital about 5,000 tonsil and adenoid operations have been performed in a year. How many of these patients were actual patients for the future, or even at that time should have been retained as patients? The familiar history of a child breathing through the mouth and incapable of blowing the nose—certainly the removal of the adenoids in the majority of these instances will greatly benefit this class of individuals. The mere fact that for a definite length of time there has been more or less complete stoppage of the nasal passages and consequently a lessened ventilation of these and neighboring parts strikes one as being far from physiologic. The normal secretions of the body soon become pathologic secretions when denied their normal flow. This is particularly so when secretions which have undergone such changes are located in positions to act in a dual rôle—first by the absorption of their toxins directly; secondly, by the disturbance of the digestion, due to their being taken into the alimentary tract. Children are notoriously more inclined to swallow nasopharyngeal discharges than to expectorate them. It demands but very low mentality to appreciate the train of disaster that may follow continued interference with the digestion, particularly in a child who requires sustenance not only for the repair which is great, due to their activities, but also to keep pace with the increase in glandular and bodily growth.

As noted by Mayer,[3] the first recorded case of sinusitis in an infant was reported by G. A. Rees.[4] In this instance, as in so many cases that have been reported since, there were signs and symptoms so definite that no mistake could be made regarding the condition present. The patient was two weeks old, there was swelling in the left cheek and all the signs of an active inflammation were present. Protrusion of the eyeball with the swelling of the eyelids and pointing below the eye, also sagging of the hard palate of the same side. Numerous cases have been reported since in infants, from the newborn to several months of age—all, however, with a very definite symptomatology. Arvellis[5] in 1898 took up the sub-

ject, and in a very strong and scathing article denied there was such a condition as maxillary sinus empyema. He claimed it to be a tuberculous infection of the bone and offers a case history in support of his view. With the advent of the roentgen ray there has been progressive advancement in the early diagnosis of sinusitis in children, but unfortunately it has not been impressed upon the minds of rhinologists and others sufficiently enough that sinusitis is so prevalent in children. Coffin,[6] one of the earliest if not the earliest, to bring to the attention of the rhinologist the prevalence of sinusitis in children, carried out an extensive series of roentgen ray examinations of children suffering from eye and ear infections, proving the association of, if not the actual cause of the above mentioned conditions. Dean[7] in a much larger number of patients comes to the conclusion that in his series about 15 per cent had sinusitis, and that as one single means of diagnosis the roentgen ray examination was the most important, although he calls attention to the fact that in the antrum of Highmore a necrosis of the floor may exist with so little discharge that a negative report is rendered, and yet be a cause of systemic reaction. The necrosis is found only upon exploring the sinus.

Being impressed with the radiographic reports so frequently stating "thickened membrane or granulations" in this or that sinus, it seemed that if roentgen ray examinations of young patients taken at random from a group of patients about to be operated upon for adenoid and tonsils (the patients having been admitted for the sole purpose of adenoid and tonsil removal), it might throw some light upon these vague reports in older subjects, therefore in this series on one operative day a week, five patients were taken from a group of children awaiting operation. The first set of five were anesthetized as for operation and then were radiographed. This proved very tedious and required much help and great care, especially as the X-ray department was on a different floor from the operating room. These things delayed the operations considerably and kept the patients under ether an inordinate length of time for an adenoid and tonsil operation. Besides these annoying conditions, the inevitable sighing or sobbing respiration was a very difficult problem to handle, from the stand-

point of radiography technic. There was also a great tendency for the nose of the patient to be flattened on the plate when in frontal position. The hands and other exposed parts of the person holding the patient's head in position were also prone to be affected by the rays after one or two exposures. The remaining 45 were radiographed without anesthesia, and out of a possible 45 only 3 refused, for upon the least sign of hesitancy they were quickly separated from the group, as an old, age long element was being used namely, "mob physiology." First, a general invitation was extended to a group of waiting patients to visit the "moving picture" room, and from the volunteers five were selected. Each patient was asked his or her favorite "movie" star and was designated as such. The most eager to be "pictured" was allowed to mount the table first, and from that time on a hearty cooperation of the others was, to say the least, highly amusing. In this way there was no delay whatever, and the personal interest of each patient was such as to endeavor to make his or her "picture" the best. Due to this factor excellent plates were obtainable. Neither punctures of the antra nor any other line of procedure or treatment as carried out in Dean's[7] series of cases were attempted. The enormous amount of operative work and the congested conditions of all wards precluded such a lengthy routine. (The main reason for such congestion was the holding in abeyance of all surgical work as far as possible during the influenza epidemic.) In taking the history of the 50 patients it was impressive to note that 32, or 64 per cent, had suffered from measles; next was whooping cough, 29 cases, or 58 per cent. Both of these diseases being a highly catarrhal nature is significant. Next in order of frequency came a history of colds, ordinary and severe, giving a percentage of 36, and then mumps, 16 per cent. A tubotympanic catarrh of varying intensity was observed in nearly all patients, but neither from the history nor by examination was any case of suppurative otitis media listed. Practically all had some degree of nasopharyngitis with discharge of varying amount from their noses. The youngest radiographed was 3½ and the eldest 9.

There is some diversity of opinion regarding sinusitis as an entity, Skillern[8] pointing out that it is a purulent infection

of the antrum, ethmoids and surrounding and intervening bone, and that in children over five years of age it is usually the termination of a socalled cold in the head, when not a sequel to scarlet fever or diphtheria, but he places great stress upon roentgen ray findings. Kerley,[9] discussing Oppenheimer's[9] paper upon sinusitis in children, said that he thought the rhinologist often overlooked cases of sinusitis in children and related how in one instance the rhinologist had cut out everything in sight and out of sight, and still the patient had a profuse discharge from the nose—the sinusitis, according to the inference, having been overlooked entirely. Much laudable work has been done, but there is still much to be accomplished in order to bring to the attention of medical men in general that this condition in children is prevalent. In this series of fifty patients the roentgen ray examinations are of intense interest, for while, as stated previously, detailed and routine examinations of the sinuses were not carried out, the report of the roentgenologist gives an affected sinus as being pathologic, minus or plus, as compared to a sinus being clear. While working out the details of these cases several patients have come under observation, suffering from a suppurative sinusitis, in whom an adenoid and tonsil operation had been performed from one to five or six years previously, but without a curative effect upon the bronchial or discharging nasal condition. All of these patients gave a history of one or more attacks of the diseases of childhood or of catching colds.

A detailed tabulation of the X-ray reports is submitted, and it may not be amiss to call attention to the fact that there is quite a difference in the findings concerning the frontal sinus and the postmortem findings of Davis.[10] Referring to the five different sources of the origin of the frontal sinus he sums up by stating that in any event this sinus has its origin from the ethmoid area. The statement is also made that as an average the frontal sinus is about 3.8 mm. above the nasion at three years of age, and advances at an average of about 1.5 mm. a year until the fifteenth year of age. This would naturally seem at variance with the X-ray findings in which so many absent frontal sinuses were noted. However, one report is an actual findings and the other is on interpretation of shadows, a diametrically opposite starting point. Assuming that

the above measurements are correct, in the youngest of the cases tabulated herewith, namely 3½ years, the upper limit of the frontal sinus should be about 4.55 mm. above the nasion, and in the eldest in which the frontal sinus is reported absent, 9 years, it should be about 12.8 mm. Considering the small amount of space involved, it is within the realm of possibility that a frontal sinus may be charted as an ethmoid cell, thereby increasing the number of frontals tabulated as absent.

It is hoped that, due to the interest of a few, children presenting themselves for adenoid and tonsil operation, upon inquiring into the past medical history revealing their having passed through an attack of one or more of the infectious diseases of childhood or of catching colds, a general interest may be aroused to undertake a searching investigation for the presence of a pathologic sinus, and if present to care for such a condition at that time. In other words, to become an expert adenotonsillectomist is not the zenith to be sought by constant application to this operation.

REFERENCES.

1. Rubner: The Military Surgeon, September, 1919.
2. Kugelmass: The Scientific Monthly, October, 1919.
3. Mayer: The Medical Record, August 10, 1901.
4. Reese: Medical Gazette, N. S., Vol. 45, 1898.
5. Arvellis: Muench Med. Wochensch., No. 45, 1898.
6. Coffin: Trans. Amer. Laryn. Assn., 1914.
7. Dean: Annals Otol., Rhin. and Laryn., June, 1918.
8. Skillern, R. H.: Jour. A. M. A., Vol. 69, No. 11.
9. Oppenheimer: Jour. A. M. A., August 30, 1919.
10. Davis: Sec. Laryn., Otol. and Rhin., Jour. A. M. A., 1918.

	AGE.	FRONTALS.	ANTRUM.	ETHMOID.	INFECTIOUS DISEASES.
1.	5	ab.	.....	.....	meas., whoopg.-cough, colds.
2.	3½	ab.	.....	.....	measles, whooping-cough.
3.	5	ab.	.....	.....	mumps, whoopg.-cough, colds.
4.	3½	ab.	.....	.....	meas., whoopg.-cough, colds.
5.	6	ab.	P—	.....	meas., mumps, whpg. c., colds.
6.	5	ab.	.....	P—	meas., whoopg.-cough, colds.
7.	6	ex. smll.	P+	P—	measles, whooping-cough.
8.	7	ex. smll.	P+	.....	measles, whooping-cough.
9.	5	vy. smll.	P+	P—	measles, whooping-cough.
10.	4	ab.	R&L. P+	P+	meas., whopg.-cough, colds.
11.	6	ex. smll.	R. P—	.....	meas., whopg.-cough, colds.
12.	7	ab.	.....	.....	measles, whooping-cough.
13.	6	ab.	.....	P—	measles, colds frequent.
14.	7	R. P—	.....	.....	colds frequent.
15.	7	.....	.....	R. P—	meas., mumps, colds frequent.
16.	9	R. ab.	R. P—	P—(sph. pr)	.....
17.	4½	.....	L. P—	.....	whooping-cough, colds.
18.	6	R. ab.	R. P—	.....	measles, whooping-cough.
19.	8	L. P—	L. P—(sph. vy. lge)		measles, whooping-cough.
20.	7	L. ab.	R. P—, L. P—	P—	measles, whooping-cough.
21.	7	.....	P—(sph. pr)	.....	measles.
22.	6	ab.	.....	P—	measles.
23.	6	ab.	P+	P—	meas., mumps, whoopg.-cough.
24.	5	ab.	R&L. P—	R&L. P—	measles, whooping-cough.
25.	7	ab.	R. P+, L. P—	L. P—	measles, whooping-cough.
26.	5	ab.	R&L. P+	R. P—, L. P+	.....
27.	5½	ab.	L. P—	L. P—	measles.
28.	5	ab.	R. P+, L. P—	R&L. P—	.....
29.	8	ex. smll.	R. P—, L. P+	R&L. P—	.....
30.	6	smll.	.....	.....	.....
31.	4	ab.	R&L. P—	R&L. P—	.....
32.	4	ab.	R&L. P+	R&L. P—	measles.
33.	6	ab.	R&L. P—	.....	.....
34.	7	ab.	R. P+, L. P—	L. P—	meas., mumps, whoopg.-cough.
35.	6	ex. smll.	R. P—	R&L. P—	whooping-cough.
36.	5	R. smll, L. ab.	R&L. P—	R&L. P—	measles, colds.
37.	7	ab.	R. P—	L. P—	.....
38.	6	ab.	.....	.....	meas., whoopg.-cough, colds.
39.	9	smll.	.....	.....	meas., whoopg.-cough, colds.
40.	5	R. smll, L. ab.	R&L. P—	R&L. P—	mumps, whooping-cough.
41.	6	R. smll, L. ab.	R. P+, L. P—	R&L. P—	meas., mumps, whpg.-c, colds.
42.	4	ab.	.....	.....	mumps, whpg.-cough, colds.
43.	5	ab.	R. P—, L. P+	R&L. P—	.....
44.	3	ab.	R&L. P+	.....	measles, whooping-cough.
45.	7	smll.	L. P—	L. P—(sph. pr)	.....
46.	4	ab.	.....	R&L. P+	diphtheria, colds.
47.	6	ab.	R. P—	R&L. P—	measles.
48.	8	smll.R.P&ex.S.L.	R&L. P+	R&L. P—(sph. pr)	measles, diphtheria.
49.	4	ab.	R&L. P+	R&L. P+	meas., whpg.-c.. diphth. colds.
50.	6	ex. smll.	L. P—	R&L. P—	whooping-cough.

10 patients gave no history of childhood diseases.
8 patients had no pathological sinus with history of childhood diseases.
32 patients with pathological sinus had history of childhood diseases.
29 patients with pathological sinus had history of whooping-cough.
8 patients with pathological sinus had history of mumps.
18 patients with pathological sinus had history of colds.
3 patients with pathological sinus had history of diphtheria.
41 patients radiographically showed pathological sinuses.

XIII.

ATYPICAL MASTOIDITIS WITH REPORT OF THREE CASES.

By Elbyrne Gill, M. D.,

Roanoke, Va.

Etiology, pathology, symptoms and signs of uncomplicated typical mastoiditis are well known to all competent otologists, and a mere narration of these conditions would be of no avail. It is the purpose of the writer to report what is to his mind three cases of atypical mastoiditis.

Case 1.—Carl D., age 11. History: March 7, 1920, left ear began discharging. March 11, swelling appeared above his zygoma. On the following day, March 12, the swelling had extended almost to the median line of the head. Also swelling extended across his face to the left eye which resembled erysipelas. On the following day, March 13, the right eyelid was swollen shut, and on March 15 the swelling had left the eyelids on both sides. The swelling above his zygoma had increased in size and was now extended to the median line of the forehead. From March 7 to March 15 the patient ran a temperature of 101 to 103. On March 15 I advised and performed a simple mastoid operation, making the regular mastoid incision, different only in that I carried the incision higher than usual. When the incision extended through the periosteum about eight ounces of pus escaped. Pus was under the periosteum. On exposing the mastoid cortex two small perforations were found, one just above and one just posterior to the spine of Henley. The mastoid cortex was opened and the antrum entered. There was no pus in the mastoid bone or antrum. The bone was in the stage of hyperemia, and there were a few granulations in the mastoid antrum. The infection from the ear and from the evacuated pus was pneumococcus. The patient left the hospital a week following the operation and made a complete and uneventful recovery. The points of interest in this case are: 1. The short aural history, which was not preceded by any systemic condition. 2. The

subperiosteal swelling was above the temporal ridge and extended to the median line of the forehead. 3. Absence of any pus in the mastoid process.

Case 2.—L. T. S., age 50, was first seen March 5, 1920. Patient gave a history of having had influenza for the week previous and was now suffering with pain in the left ear. Physical examination revealed a red and bulging drum membrane, which was incised and was followed by profuse discharge. Patient did not give history of any previous ear trouble. The discharge continued for two weeks, during which time the patient had no mastoid tenderness and no pain but was running a temperature of 101 to 102½ each day. At the end of two weeks, on account of the profuse discharge, which showed a pneumococcus infection and considerable elevation of temperature, I decided to send the patient to the hospital, where she could have an X-ray examination of the mastoid as well as of the chest. The X-ray examination of the mastoid showed increased density and cloudiness, but was not operative from an X-ray standpoint. The X-ray examination of the chest revealed a resolving bronchopneumonia. In a few days her chest condition cleared up and her temperature dropped to the normal line and remained so for an entire week, during which time the aural discharge continued to be profuse. During this week the patient had absolutely no pain and no mastoid tenderness, and the second X-ray examination of the mastoid showed a slight increase in the density and cloudiness but was not operative from an X-ray standpoint. The physical examination of the fundus of the ear showed a distinct sagging of the posterosuperior wall. In spite of the negative X-ray reports and the normal temperature for a week and absence of any other signs of mastoiditis a simple mastoid operation was advised for the following reasons: 1. There had been a continuous and profuse discharge for three weeks, with no sign of abatement. 2. The distinct sagging of the posterosuperior wall. The operation was done March 26, 1920. On opening the mastoid cortex, which was very thick, a profuse amount of pus escaped which was under pressure. The entire mastoid process was broken down throughout. There were a large number of postsinus cells. The entire mastoid tip was broken down and was removed. A small area

of dura was exposed in the middle fossa. The sinus was not exposed. The patient left the hospital one week following the operation. On May 10, 1920, her hearing in the operative ear was practically as good as in the other. The points of interest in this case are as follows: 1. The absence of mastoid tenderness. 2. Normal temperature for one week preceding the operation. 3. Entire absence of pain. 4. The two X-ray examinations which did not indicate an operation from an X-ray standpoint.

Case 3.—D. L. R., age 56, was first seen April 20, 1920. Patient gave the following history: On April 18, patient began having pain in the right ear. Had had tonsillitis for a week previous. Physical examination on April 20 showed a marked furuncular condition of his external auditory canal. The swelling was so extensive as to prevent a satisfactory examination of the drum membrane. Patient had considerable pain and marked tenderness of the mastoid tip but not of the mastoid antrum. Pressure on the tragus caused severe pain. His temperature at this time was 103. My diagnosis at this time was furunculosis of the external auditory canal. The patient was placed on treatment for this condition, and when seen on the following day, Wednesday, April 21, was feeling more comfortable and his temperature was 101. The swelling of the external canal still prevented a satisfactory examination of the drum membrane. On Thursday morning, April 22, I received a telephone call from a member of the patient's family saying that his condition was worse than it had been and that he was suffering most excruciating pain. Examination at this date showed a small perforation in the superior quadrant of the drum membrane in the region of the vault. From it there was escaping a small amount of serosanguinous discharge. Patient was exceedingly tender over entire mastoid process. I was satisfied that the patient was suffering from suppurative mastoiditis, and upon that conviction I advised an operation. The X-ray examination revealed a marked increased density and cloudiness of the bone. The bacteriologic examination of the aural discharge showed a pneumococcus infection. On Thursday, April 22, 1920, a simple mastoid operation was performed. The entire mastoid process was very soft and broken down. Pus was present in the mastoid tip

and mastoid antrum. A number of large cells were found posterior to the lateral sinus. Four days following the operation the patient developed erysipelas which disappeared after a week's duration. Patient left the hospital two weeks following the operation and has made a complete recovery. The points of interest in this case are as follows: 1. History of ear trouble which was of only four days' standing. 2. The extensive furuncular condition which to a certain extent masked the symptoms arising from the middle ear.

XIV.

ACCIDENTS IN AURAL PARACENTESIS.

By Jerome F. Strauss, M. D.,

Chicago.

A severe hemorrhage from the ear, necessitating actual hemostatic measures for control, and a similar case with a less severe but continuous loss of blood for a period of several days occurred some time ago in my hospital service, following incisions in the tympanic membrane for acute purulent otitis media. These accidents, being the first of my experience and also in the larger experience of those gentlemen with whom I am associated, led me to search otologic literature with the idea of obtaining some information regarding the frequency of such cases. I have found but little to reward my search, either because accidents of the kind are rare or because professional pride places such episodes in the category of unreportable cases. I found in all less than twenty references to the subject, but sufficient, I hope, to interest you for a few moments.

When Riolanus first suggested the perforation of the tympanic membrane as a relief for deafness, in the middle of the seventeenth century, his proposal was based on the result of the accidental perforation of the drum in a deaf patient with subsequent partial restoration of hearing. His contention, and that of Plemp a few years later, that air was necessary in the tympanic cavity to permit normal hearing, was supported by Valsalva's demonstration that there was a passage of air from the mouth to the middle ear. The operation was first performed by Valsalva in 1740 without success, and again by Eli, who has something of the reputation of a charlatan, in 1760. The latter's success or failure is not on record.

In 1800, Cooper, who first published the experiments of Wm. Cheselden, cited four cases of deafness cured by perforation of the ear drum. These cases, together with a successfully operated case reported by Hymly, aroused a marked degree of enthusiasm in the profession and even among the

laity; and for a short time paracentesis was hailed as a panacea for deafness. Hymly and Cooper gave as indications for the operation the closure of the eustachian tube and blood extravasation into the tympanic cavity. Saunders, of London, in 1804, was probably the first to recommend empyema of the tympanum as an indication.

These indications were not universally accepted by the profession, and a great number of the medical men of the period practiced and advised the puncture as a cure for deafness. This large group includes such names as Ribes, Itard, Dubois and Deleau in France, S. Cooper, Hunold and Wright in England, and Rust, Kawerz and Arneman in Germany. In consequence of the activity of this school and the relatively few successful results of their work, the general enthusiasm was soon dampened, and the emphasis by Hymly on the fact that the operation could be applicable in only certain selected cases brought about a temporary discarding of the operation.

The accidents in the early days of paracentesis were many and varied. The records are, of course, meager and inexact, and in the light of present day knowledge, were practically entirely due to infections and the crude instrumentation of the time. Thus, Hymly, in 1806, cited examples of grave and fatal accidents following perforation, and Fuchs, in 1810, reported many cases in which the operation was followed by headaches, convulsions, and fevers of a serious nature. It is probable, judging from the incomplete evidence now obtainable, that the fatalities which occurred were due to sinus thrombosis, meningitis and intracranial abscess. Muller, in his inaugural dissertation at Halle in 1890, stated that the operative procedure was considered relatively if not absolutely free from danger until the middle of the nineteenth century when deaths were reported by Hubert-Valleroux in France and by Butcher, an English physician.

Secondary infection of the ear cavity was a frequent occurrence in those cases in which paracentesis was performed to relieve deafness. Schwartze found it in 20 per cent of the cases operated upon at Halle, and he intimates that this percentage increased proportionately as new and more complicated intraaural operative procedures were devised.

In present day otology the one accident complicating incision of the tympanic membrane in ordinary cases of suppurative otitis media seems to be extensive hemorrhage. The first case on record is mentioned by Gruber in the 1888 edition of his textbook. The accident occurred with a patient whose drum membrane had been opened a few days previous uneventfully. Symptoms requiring a repetition of the operation developed, and an incision was made in the posterior inferior segment. The blood poured out so copiously that it appeared as if a large vein had been divided. More than ten ounces of blood were lost before the hemorrhage was controlled by tightly packing the canal with cotton wool soaked with perchlorid of iron.

In 1890 Ludwig reported the first case of such hemorrhage in periodic literature. In this case a translucent blue coloration was noticeable in the posterior inferior quadrant, but was not considered of any importance. The first incision permitted a clear serous fluid to escape, and the opening was then dilated with a needle. This maneuver brought forth a sudden stream of dark blood which filled a large pus basin before the canal was effectively packed with firm tampons. Recovery was uneventful.

Hildebrant reported a case in 1891 occurring in a rhacitic child showing well marked deformities of the joints and cranium. Paracentesis was performed on a lusterless, reddened bulging membrane in the usual manner. Immediately there escaped a stream of venous blood as large as the small finger in diameter. Because the canal was promptly packed the loss of blood was not great. It was shown later on this patient that the light reflex on the affected side changed its shape when the internal jugular vein of that side was compressed. It was also noted that all the veins of the neck and scalp were enlarged on this side.

The first fatal case was reported by Brieger in 1892. After paracentesis of the membrane in this case, the incision was enlarged with the pointed galvanocautery, and the jugular vein was perforated. The hemorrhage was readily controlled by tamponade, but pyemia and death resulted.

Seligman demonstrated a case of injury to the bulbus vena jugularis during paracentesis, in 1893, and McKernon reported

the first instance of the kind in this country in 1894. The latter case McKernon claimed was arterial hemorrhage, the blood spurting out with rhythmic pressure for a distance of two feet. Firmly tamponing the canal, and pressure on the carotid artery for half an hour controlled the bleeding.

Other instances recorded are those of Max (1905), Castex (1905) and two of Lueder's (1912). Castex's patient developed a facial paralysis nine days after the injury to the bulb. In one of Lueder's cases bleeding recurred in spite of all external precautions, and it was necessary to expose the lateral sinus and pack above and below the bulb. Pyemia developed in this case and resulted fatally.

The anatomic changes necessary to produce these accidents are not many. A congenital absence or thinning of the bony capsule of the bulb may exist, or the condition may be acquired through metabolic disease in the early developing years of life. Friedlowsky, in 1868, published a report on the dissection of one thousand skulls, in only one of which the bulb protruded into the tympanic cavity. Muller found more frequent anomalies, and these occurred in skulls which showed other anatomic defects of bone formation, partly congenital and partly as a result of rhacitis. The cases of Ludwig, Hildebrandt and Max, cited above, were definitely rhacitic, the osseous changes being apparent in joints and skull. Körner in 1892 published his study of two negro heads, wherein, had paracentesis been performed, severe hemorrhage could scarcely have been avoided. Zuckerkandl, Toynbee, Von Troltsch and others have made similar observations, and I might add the unusual case of Lannois, a "venous hernia," in which the jugular fossa was dilated to an extent that it replaced the middle ear cavity and a portion of the external auditory canal.

In 1903 Hansen reported a case in which the internal carotid artery coursed through the tympanum in such a way that if the ear drum had been incised during life the vessel must have been seriously injured. A similar case was published by Max, discovered during life, attention being called to it by the rhythmic pulsation of the drum synchronous with the heart beat, and which was not apparent after firm pressure was applied to the internal carotid artery. It is very probable that McKernon's case was one of this type, in which, during

violent exercise the artery or an anomalous branch ruptured within the tympanic cavity and thus produced the symptoms for which the ear drum was incised.

The following cases attracted my attention to the literature on this subject:

Case 1.—C. S., age 8 years. After thirty-six hours of acute earache he had been taken to a physician's office, where, after otoscopy, a paracentesis was performed, following which there was an immediate gush of blood from the auditory canal, which evidently was sufficient to cause concern to the operator, who hastily inserted a firm wad of cotton and brought the patient to the hospital. When seen by us, blood was steadily oozing through the temporary packing. On removal of the cotton wad the gushing of venous blood was resumed, and the only course to pursue was immediate firm repacking of the canal. This served to control the bleeding and the patient recovered uneventfully. The patient was subsequently examined by Dr. Abt, who was able to demonstrate a Harrison's grove, some deformities of the heads of the long bones and the remnants of a rhacitic rosary.

Case 2.—B. D., age 7 months. This infant was brought to the hospital forty-eight hours after a paracentesis, during which period he had continued to ooze a slow but steady drip of blood from the ear. The little canal had been packed with gauze twice without success, and the condition was becoming serious. Pallor was marked and pulse rapid.

An adrenalin soaked tape was inserted deeply into the canal and tightly packed. This treatment evidently slowed up the hemorrhage, for though the packing was blood soaked in a few hours there was no further bleeding. Subsequent history and examination revealed the fact that the patient was a hemophiliac. The patient made a recovery after treatment with horse serum, which was in vogue at the time, and a course of calcium internally.

XV.

ASTHENIC HYPOACOUSIS.*

By H. J. Inglis, M. D.,
Boston.

Fatigue of the auditory nerve as it appears in its aggravated forms, such as occupational disease, and in certain phases of neurasthenia is commonly recognized and promptly classified by the average aurist. I doubt, however, that the loss of auditory function as an indication, or a consequence of general debility, is given the discriminating consideration and the importance which it deserves in the differentiation of nonsuppurative forms of ear disease.

Dr. Emerson and others have told us of the effects of toxins, emanating from infected tonsils and suppurating nasal sinuses, which exercise a selective action upon the auditory apparatus. The type of cases which I wish to consider are independent of toxemia, having as their etiology overwork, mental strain, prolonged anxiety, and other conditions resulting in lowered physical and nervous vitality.

The recognition of this type of disorder is most important from the standpoint of prognosis; for the outstanding features which the functional examination shows are diminished bone conduction and lowering of the upper tone limit, and we are very apt to look upon these points in a hearing test as discouraging evidence of actual degeneration of the sound perceptive apparatus.

From a rather large amount of material I have selected for study fifty cases of asthenic hypoacousis which are "pure"—that is to say, from them all possibility of confusing concurrent conditions such as middle ear dsiease, syphilis, hysteria, etc., has been eliminated. These fifty cases have been divided into three groups according to the characteristics of the hearing tests.

These groups are: 1. Those showing little loss of quantitative hearing, diminished bone conduction and lowering of the

*Candidate's thesis. American Laryngological, Rhinological and Otological Society.

upper tone limit. 2. Those showing noticeable loss of hearing, diminished bone conduction and no disturbance of the upper tone limit. 3. Those showing noticeable loss of hearing, diminished bone conduction and lowering of upper tone limit.

In none of these cases is the perception of low tones affected. Tinnitus and various types of discomfort about the ears are common but not characteristic.

Only a few cases fall into Group 1, chiefly because most of these were discovered by chance while the patients were being examined for some entirely different condition. Also many cases which might have been included in this group were discarded because of a possible hysterical element.

This group is typified by the story of a gentleman who had brought himself up, by hard work, from a humble position to one of great responsibility in a manufacturing concern, and who was induced by a medical friend, interested in the relation of physical fitness to business efficiency, to undergo a general physical examination.

He went about it with characteristic thoroughness, entered a private hospital for twenty-four hours and was examined by an oculist, an aurist and an internist. His urine was examined, the Wassermann test performed and an X-ray examination for abscessed teeth carried through.

The story which he told of his present condition was that he was tired and somewhat nervous, worked very hard, had occasional palpitation, and, about every ten days, had severe headache centering in his eyes, which he ascribed to overwork. He did not use alcohol or tobacco. He was 44 years old.

The positive findings on examination, as submitted by the various men were: Blood pressure, 164-120; slightest possible trace of albumen and very rare small fine granular casts in the urine; refractive error well corrected by glasses, and considerable strain of the eye muscles, due to overuse; some pyorrhea alveolaris and hemorrhoids. His hearing test showed:

A.D. 20/20	40/12	16	1.00
W.V. (Numbers)	Rinné (512)	Low limit (Dench fork)	Upper limit Galton
A.S. 20/20	40/15	16	.9

The unanimous diagnosis was overwork.

In Group 2, which comprises 38 per cent of the cases, comes a professor of music in a large college, who had just finished his year's work.

Three years previously he had had tinnitus for a while, which disappeared spontaneously. There was no further trouble until one week before he presented himself for examination, when his ears began to feel stuffy and a buzzing tinnitus intruded. He had recently felt tired and nervous.

Examination of ears, nose and throat showed nothing of moment. His eustachian tubes opened easily and inflation did not affect his hearing or his tinnitus.

His hearing test showed:

A.D. 10/20	60/20	16	N
W.V. (Numbers)	Rinné	Low limit (Dench fork)	High tones
A.S. 12/20	50/18	16	N

Group 3 produced 50 per cent of the cases and includes a lady 47 years old, an employe of a publishing house, who had suffered great and prolonged mental distress.

Her general physical and nervous condition was deplorable. She fainted during the examination.

For about one year she had been growing deaf in her right ear. The hearing in her left ear had recently fallen off steadily and rapidly.

Her hearing test showed:

A.D. 4/20	50/20	16	1.00
W.V. (Numbers)	Rinné (512)	Low limit (Dench fork)	Upper limit Galton
A.S. 3/20	40/12	16	1.00

The details of the history and examination in these cases have been rather sketchily presented, but let it be understood that what has not been mentioned did not occur. Each case throughout the series was completely examined as to nose, throat, nasopharynx and eustachian tubes, and, where indicated, a general examination was obtained and the investigation completed with X-ray plates and the Wassermann reaction.

One lapse in the functional examination needs explanation. That is the use of numbers only, in estimating the perception of the whispered voice. This method is, in a measure, inaccurate; for patients with their attention fixed on certain known sounds, where combinations are limited, will more easily interpret these sounds than they will those represented by isolated words or a series of words making up a sentence. The result is that their perception for voice is overestimated.

On the other hand, the use of numbers has an advantage in so far as high and low pitched sounds may be systematically employed at will, the result easily recorded and an adequate basis is established for comparison in future tests. In a whispered sentence we not only bring in the element of enunciation but letters and syllables of varied pitch are uncontrollably intermingled, and it is very difficult to record the results, unless the same words and sentences are employed at subsequent examination. This is particularly true in these cases where the nerve is quickly fatigued.

From the material in hand I have tried to produce a sort of composite hearing test representative of auditory asthenia, in order to form a comparison between it and the derangements produced in other disorders of the cochlear nerve. This empiric record has been produced by a general averaging of the various tests with the exception of the Rinné, which is founded on an average of the air conduction and a ratio estimation of the bone conduction. The result is as follows:

Whispered voice	Rinné	Low limit	Upper limit Galton
14/20	50/17	16	.9

The Weber test is uncertain. As a rule it simply follows to the ear with the best bone conduction.

Although the above is an average of the perception for whispered voice and high pitched sounds, in some cases the former was as low as 1/20, and loss of high tones as much as 2.1 on the Galton whistle.

The condition is usually bilateral with the two ears showing a fairly uniform deterioration.

In examining this hearing test the one distinguishing feature which is apparent is the preservation of air conduction for the C2 tuning fork used in the Rinné, and in going over

the whole series no case was found in which duration of perception for the C2 fork by air was below the normal limits, even where the whispered voice and perception of high tones were most affected. In other words, within the ordinary register, the defect in function is failure of the capacity for the fine discrimination required in selecting and coordinating sounds rather than the lack of response to simple tone.

Of course, where there is a defect in the peripheral portion of the sound perceptive apparatus, regardless of pathology, the functional examination must show fairly uniform results; but it is interesting to compare simple asthenia with some of the other diseases from the standpoint of the Rinné tests.

For example: In secondary degeneration of the organ of Corti following long standing middle ear disease, we find such a hearing test.

Forced whisper	Rinné	Low limit	Galton
8 in.	5/0	512	2.00

Occupational disease in a man who worked many years in a boiler shop gives us the following:

Whispered voice	Rinné	Low limit	Galton
2/30	10/10	64	20

The effect of large doses of quinin is shown in this:

Whispered voice	Rinné	Low limit	Galton
4/20	20/15	16	2.00

Advanced otosclerosis showed:

Forced whisper	Rinné	Low limit	Galton
6 in.	14/22	96	2.5

In all of these examples (actual ones taken from records) the proportionate falling off of the air conduction for the C2 fork is obvious.

The nearest approach to the tests found in asthenia of the auditory apparatus is shown in a case of active secondary syphilis which had not been treated. Incidentally this young man laid his difficulty to overwork and excessive outdoor speaking, for he was engaged in lecturing to soldiers on sexual hygiene and the curse of "social diseases."

He gave the following results:

A. D.	1 foot	30/10	16	.9
	Forced whisper	Rinné	Low limit	Galton
A. S.	1 foot	40/10	16	1.2

He had a secondary rash and a positive Wassermann.

A short time ago loss of bone conduction was given a good deal of attention as a diagnostic point in syphilis. This has recently been descredited to a large extent, and I venture to say that while a large proportion of cases that have syphilis actually involving the auditory apparatus may have reduced bone conduction, in the general run of patients, nervous debility will be found to be responsible for the loss of bone conduction much more frequently than syphilis.

Auditory neurasthenia must not be confused with hysteria. The latter is always easily detected by the variety of results obtained in repeated hearing tests. One case gave me in three hearing tests in a few days the following results for the Rinné:

A. D.	40/10	60/28	60/10
A. S.	55/20	58/23	45/15

In asthenic hypoacousis, then, we have patients who tell a story of general fatigue or nerve strain, a rather sudden realization that they do not hear conversation as well as formerly —perhaps of tinnitus, a sensation of stuffiness or slight shootings pains about the ears. Vertigo is not particularly common.

Upon examination there is no serious abnormality found about the nose or throat, the appearance of the tympanic membrane gives no impression of disease, and the eustachian tubes are normal patent. The functional examination shows a certain degree of loss of hearing for the whispered voice, relatively high preservation of perception by air of the C2 fork and absolute diminution of perception for the same fork by bone conduction, the apprehension of low tones unaffected and in the majority of cases a lowering of the upper tone limit.

When we have a pure case of asthenia presented the diagnosis should be fairly easy. Unfortunately, it is often confused by the coincidental existence of some other form of disease. This is most likely to be simple chronic otitis media and, as a rule, careful scrutiny of the hearing test and a shrewd estimation of the potential pathology about the nose and throat, especially if the middle ear disease be one sided, will serve to disentangle the two elements of the disorder. If, how-

ever, the complicating disease is one involving the labyrinth or auditory nerve the immediate diagnosis is difficult.

The failure to properly segregate the neurasthenic element from other complicating conditions undoubtedly explains the surprising improvement which sometimes occurs in patients whom we have considered the victims of an incurable form of deafness.

As was mentioned at the beginning, the recognition of auditory neurasthenia is of great importance from a prognostic standpoint; for in this disease the prognosis is good for the recovery of a large part of the lost hearing, whereas, in the other conditions where the functional examination gives similar results the prognosis is bad.

The recovery of the hearing is directly dependent upon the individual's capacity for recuperating his general condition. Under favorable conditions, even where the perception for voice has fallen off considerably, the restoration of function may be rapid, as is shown in the case described above to illustrate Group 3. At the end of two weeks, after a course of general treatment had been instituted, her perception for whispered voice had more than doubled.

Under rigid general treatment, in cases where the change in the upper register is slight, and the relative loss of bone conduction in the Rinné does not exceed one-third, one can promise the patient practically complete recovery. The dropping of the high tones and the loss of bone conduction are the factors which determine the measure of recovery, rather than the extent to which the perception of voice has suffered. By the time the upper tone limit has been reduced to 1.00 on the Galton and the perception for the C2 fork by bone has fallen below ten seconds the promises of recovery must be restricted.

One word must be added in regard to treatment. It does not suffice to give the patients a tonic and tell them to rest, but rather they should be entrusted to the care of a patient and careful internist who is capable of carrying out a scientific regulation of the patient's daily life.

Local treatment is of little use.

XVI.

PARALYSIS OF THE EXTERNAL RECTUS IN THE RIGHT EYE FOLLOWING MASTOIDITIS IN THE LEFT EAR.

By Dunbar Roy, M. D.,

Atlanta.

There has been reported by several observers such a fairly authentic number of cases of abducens paralysis of the eye in conjunction with diseased conditions of the middle ear and mastoid, as to make the subject one of clinical interest and to establish the fact that it is a complication by no means of infrequent occurrence.

Practically all of the cases reported have shown the paralysis to exist on the same side as the ear involved, and it is for this reason that I present the following case where the abducens paralysis occurred on the opposite side.

In the last few years this subject has been much discussed and several cases reported under various captions. The most exhaustive article has probably been written by Dr. Chas. E. Perkins, published in the Annals of Otology, Rhinology and Laryngology, for September, 1910. All the succeeding writers have referred extensively to this article and have really made it the basis of their own conclusions. The article by Dr. John M. Wheeler in the A. M. A. Journal, November 23, 1918, and the one by Dr. T. J. Maybaum of New York deal with the report of cases and at the same time discuss the subject in a very similar manner.

Ophthalmologists recognize the fact that isolated paralysis of the abducens nerve is by no means of infrequent occurrence. Its etiology in the large majority of cases is obscure. In 1919 the writer read a paper before this society on "Malignant Diseases of the Sphenoid Sinus" in which he called attention to the fact that the paralysis of the abducens nerve was one of the first symptoms observed and gave in detail its anatomic position, showing that it was the one most easily

affected from pressure of any character at the base of the brain or even a slight meningitis. For this reason it is very difficult to trace the etiology of abducens paralysis unless an unfortunate postmortem should have given this important information, as has been mentioned by Perkins in his very excellent bibliography. Isolated cases of abducens paralysis bear a strong resemblance to the isolated cases of facial nerve paralysis. The etiology of both of these conditions is quite obscure, and yet if they occur in conjunction with a middle ear involvement their etiology takes on a more definite aspect. Syphilis, rheumatic diathesis, catching cold, are all supposedly a possible cause for these isolated paralyses, but just what is the real anatomic pathology can only be conjectured.

Extension of an inflammation from the middle ear and mastoid along the various routes mentioned by Perkins would certainly be sufficiently explanatory in the large majority of cases, but where the paralysis occurs in the abducens on the opposite side from the ear involved, it is quite difficult to arrive at a satisfactory explanation. One of the triad symptoms —i. e., severe pain on the side of the face, was entirely absent in my case, which would lead us to conclude that the gasserian ganglion was not involved. The peculiar feature in this case was the opposite side paralysis showing the difficulty in tracing its pathology, and following its clinical report I have taken the liberty of compiling a report of all cases to be found in the literature where the paralysis occurred in the eye opposite to the ear involved.

L. J., white, age 10½ years, was brought to my office by his physician on July 17, 1915, with the following history:

On January 3, a month previous, the patient was suddenly seized with an earache in the right ear. Six days later it began to discharge, following which all pain and fever disappeared, and with the exception of the discharge the patient seemed thoroughly comfortable. On July 4, one month after the initial symptoms, the discharge suddenly ceased, some pain returned and a swelling developed over the mastoid. This was treated by his physician without results, hence the consultation. The writer was requested to take charge of the case. The temperature at this time was 101 F. The swelling over the mastoid was tender and fluctuating, showing every

evidence of a subperiosteal abscess. The patient's appearance was cachectic.

He was immediately sent to the hospital, and next day, February 18, a complete exenteration of the mastoid was made. On making my incision no pus escaped as was expected but, on the contrary, we found the swelling due to an enlarged gland. Underneath this the cortex of the mastoid was soft and the whole tip was found to be necrotic. There was very little pus in the antrum, but the sinus was exposed when necrotic sequestra of bone were removed. The cavity was lightly packed with iodoform gauze and the lower end of the wound left open. This was removed on the fifth day. There was never any pain or rise in temperature. Patient left the hospital in one week. The next day after the operation it was noticed that the patient kept the lids of the right eye closed, although they could be voluntarily opened. Two weeks after the operation the wound was nearly healed, and for the first time the writer noticed a paralysis of the left external rectus with the consequent internal strabismus of the same eye. The patient also complained of diplopia.

Examination showed vision to be normal in both eyes and absolutely no fundus changes. Three weeks after the operation the mastoid cavity was healed, showing remarkable tissue vitality, the only complaint being the double vision. A Wassermann examination was negative, as also a tuberculin test.

The patient was placed upon gradually increasing doses of the iodid of potassium and allowed to go away in the country. Two months later he was again seen and the hearing test showed this to be normal. He had much improved in appearance, having gained ten pounds. The paralysis was gradually subsiding. On June 15th, five months after the initial symptoms of middle ear suppuration, the patient had recovered and the paralysis of the external rectus had entirely disappeared.

CASE REPORTS AND COMMENTS.

Rimini, S.: La paralysis de l'oculomoteur externe d'origine auriculaire. Arch Internal. de Laryngol., XXI, 125, 1906.

One case in a child aged 7. Bilateral otitis after scarlatina, followed by mastoiditis on the left side; mastoid operation.

After the operation patient complained of frontal headache, pain in the left eye and diplopia. Examination showed paralysis of the external rectus of both eyes, at first more marked on the right side. As this paralysis in the right side gradually diminished, that on the left side gradually increased. In two months all eye symptoms had disappeared.

Collinet: Meningite d'origine otique avec paralysis due moteur oculàire externe. Bull. d. Laryngol., Otol. and Rhinol., X, 90, 1907.

Reports one case in a young woman age 20. In August, 1905, suppurative otitis in the left ear, the pain being alleviated when ear began to discharge. Toward the end of September, return of symptoms with severe headache, nausea and constipation. Diplopia noted at this time. In the early part of October symptoms became more severe, with evidences of meningitis, and the mastoid operation was performed. Before the operation a very decided strabismus in the right eye was observed. After the operation all symptoms improved, but the eye muscle paralysis persisted for some time, diminishing gradually. Four weeks after the operation the right eye could be normally abducted, and diplopia was noted whenever the patient was tired. These symptoms finally disappeared entirely, and the patient was in excellent general health after a rest in the country. No lumbar puncture was done in this case, but the symptoms indicated meningitis. The paralysis of the external rectus of the eye on the side opposite to the diseased ear is difficult to explain; there was evidently some lesion along the course of the nerve which healed gradually.

Quadri, A.: Otite meyenne aigue gauche; mastoidite; paralysis de la sixieme pairs du cote droit. Rev. hebd. de laryngol., II, 100, 1908.

One case, man, age 48. Acute otitis in the left ear. In spite of repeated paracentesis and thorough drainage of the ear, mastoiditis resulted, and the mastoid operation was performed; no cerebral lesion. Four weeks after the operation the patient complained of headache; a cervical swelling developed on the left side which was repeatedly drained. The patient one day complained of diplopia, and examination showed paralysis of the sixth cranial nerve on the right side. This paralysis lasted

36 days. The cervical phlegmon did not heal for several months. The author is unable to explain the eye paralysis in this case.

Furet, F.: Otite suppurée droite ancienne; mastoidite; operation. paralysie de la sixieme paire gauche; guerison. Ann. d. mal. de l'oreille, du larynx (etc.), 34, 659, 1908.

Reports one case observed in 1895. Boy, age 14; chronic suppurative on the right side. Mastoid operation. Fifteen days later, patient saw double, complained of severe headache. Examination showed paralysis of the sixth cranial nerve on the left side; nystagmus and diplopia.

General condition of the patient improved, and eye symptoms had disappeared in a month.

Commenting on the case, the author notes that this paralysis of the external rectus of the eye on the side opposite to the diseased ear is very rare. He has found in literature only two other cases—Collinet and Quadri.

Savariaud and Dutheillet de Lamothe: Un cas de meningite sereuse otogene guerie avec paralysie du moteur oculaire externe du cote oppose ã la lesion auriculaire. Bull. d'oto-rhino-laryngol., XV, 206, 1912.

One case in a child aged 8½ with acute otitis and symptoms of meningitis on the right side. Operation at which an extradural abscess was found. The day after the operation, horizontal nystagmus, five days later a sudden rise in temperature and meningitis with the cerebrospinal fluid under greatly increased pressure. Condition was greatly improved by repeated lumbar punctures, but two days later, paralysis of external rectus of the eye on the left side developed with diplopia and internal strabismus. At the time of the report the child was in excellent general health, but the ocular paralysis was still present, although gradually diminishing. The mastoid operation was done on December 21, 1911; the date of the report was February 9, 1912.

Paullier, A.: Contribution a l'etude des paralysies de la vle paire cran iene survenant au cours de lesions auriculaires du cote oppose a ces lesions. Paris Thesis, 1912.

Pallier reviews the cases cited above and adds the following from the literature:

1. Bonnier (Compt. rend. soc. d. biol. ser. X, 2, 368, 1895). After the Stacke operation for a chronic otitis in the left ear patient complained of seeing double, and of incessant vertigo. The left eye was in forced adduction; this condition later extended to the right eye, probably due to paralysis of abducens extending from the left side to the right.

2. Strazza (Arch. ital. d. d. otol., XVIII, 403, 1907). Patient age 51; otitis media on left side with mastoiditis. Previous to the mastoid operation, paralysis of the abducens nerve on the left side was noted; about one month after the operation headaches recurred, and a paralysis of the abducens on the right side developed. The symptoms gradually disappeared.

3. Blauluet (Report to societe parisienne d'tologie, 1909, original not found here). Patient 18, otitis in the right ear in March, 1908, resulting later in mastoiditis, for which the mastoid operation was performed on April 7, 1909. Previous to operation the patient saw double, and a slight strabismus was noted in the right eye. After the operation, on April 12, convergent strabismus and diplopia due to a paralysis of the external rectus of both eyes developed, but more accentuated on the left side. Lumbar puncture showed increased pressure of cerebrospinal fluid; after the puncture the eye symptoms greatly improved, and in a short time disappeared altogether.

The author in discussing these cases points out that where lumbar puncture has been performed, it has always shown increased pressure of the cerebrospinal fluid. He believes that paralysis of the abducens nerve on the side opposite to the diseased ear is due to the increased pressure of the cerebrospinal fluid acting upon a nerve which for some cause or other shows diminished resistance.

In treatment, he believes no further operation is necessary except to insure proper drainage of the diseased mastoid. Lumbar puncture, however, is indicated until the cerebrospinal hypertension is reduced.

Rousseau, F.: Les paralysies des nerfs moteurs le l'oeil au cours les otites moyennes suppurees et leurs complications. Ann. d'ocul., CLIII, 530, 1916.

Rousseau states that the paralysis of the external rectus of the eye in otitis is usually noted on the side of the affected ear, but may be observed on the opposite side and exceptionally is bilateral. In cases where the rectus paralysis occurs on the opposite side he considers that it must be due to cerebrospinal hypertension compressing the nerve trunk of the abducens. Cites no new cases.

Wheeler, J. M.: Paralysis of sixth cranial nerve associated with otitis media. J. Am. M. Ass., LXXI, 1718, 1918.

Wheeler reports one case with mastoiditis on the left side, operated upon on February 13, 1918. On examination on March 9 the patient "exhibited a most interesting condition in a double external rectus paralysis (complete on the right side and partial on the left) without any involvement of the other muscles of the eye." It is to be noted in this case that the paralysis, while bilateral, was most complete on the side opposite to the affected ear.

ADDITIONAL BIBLIOGRAPHY.

Baldenweck, L.: Les altérations du ganglion de Gasser et de la vie paire au cours des inflammations de l'oreille moyenne. Ann. d'ocul., CXXXIX, 246, 1908.

Baratoux, J.: De la paralysie du moteur oculaire externe au cours des otitis. Arch. Internal. de Laryngol., XXIII, 63, 414, 1907. Also in Pratique méd., XXI, 33, 49, 1907.

Barr, J. S.: Paralysis of the Sixth Cranial Nerve Consequent Upon Chronic Purulent Middle Ear Disease. J. Laryngol., XXIII, 553, 1908.

Downey, J. W.: One Hundred Cases of Mastoiditis and Its Complications. Ann. Otol., Rhinol. and Laryngol., XXV, 994, 1916.

Graham, H. B.: Gradenigo's Syndrome: Analysis of Published Cases. Laryngoscope, XXVIII, 1146, 1913.

Kerrison, P. P.: Abducens Paralysis Complicating Mastoiditis. Med. Rec., XCIV, 941, 1918.

Lannois and Perretiere: Paralysis du moteur oculaire externe d'origine otique. Bull. Soc. méd. d. hop. de Lyon, V, 72, 1916.

Perkins, C. E.: Abducens Paralysis and Otitis Media Purulenta. Ann Otol., Rhinol. and Laryngol., XIX, 692, 1910.

Sauvineau: Les paralysies oculaires dans les affections de l'oreille. Ann. d'ocul., XXXVIII, 321, 1907. Notes the same case published by Fauret.

Schwarzkopf: Die otogene abducenslahmung: Sammelreferat. Internat. Centralbl. f. Ohrenheilk., V, 215, 1907.

Sears, W. H.: Isolated Paralysis of the External Rectus in Acute Suppurative Otitis Media. Penn. M. J., XIII, 844, 1909-10.

Grand Opera House.

SOCIETY PROCEEDINGS.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Meeting of November 3, 1920.

THE PRESIDENT, DR. ALFRED LEWY, IN THE CHAIR.

Sebaceous Cyst of the Mouth.

Dr. Otto Stein reported a sebaceous cyst of the mouth and exhibited the patient and the cyst. This case was first seen by Dr. Stein three or four months ago. A young woman appeared at the hospital with her mouth so full that she could scarcely talk or swallow. At that time, about the middle of July, she was beginning to have difficulty in swallowing and great interference with speech. She had very little pain, only from the inconvenience from the size of the growth. Examination showed a mass in the floor of the mouth, which was a smooth symmetrical swelling. There was no inflammation, no particular soreness, and it was cystic to the touch. The mass pushed the tongue away up to the roof of the mouth, and below the chin in the sublingual region was a similar swelling which on palpation one could readily feel was a part of the mass in the mouth. The tumor was about the size of a small orange. The speaker was not sure whether it contained fluid or not. He decided to use a local injection and make an incision in the floor of the mouth, which he did under 1 per cent procain, which gave very good anesthesia. After making the incision through the mucous membrane only, he came down upon the sac and started to dissect it, but found it was too large to remove that way unless he emptied the contents through a small incision. Opening the sac readily revealed the contents to be sebaceous material. All of it was practically scooped out before any attempt was made to remove the sac; otherwise, he would have had to enlarge the incision considerably. The dissection was very easy, and the cyst was removed through a small incision. He exhibited the mass he removed in its entirety, containing whatever sebaceous material was left. There was a narrow prolongation in the median line in the submental region. Cysts of this type may appear anywhere along the branchial cleft. The patient had had no difficulty since the operation.

Dr. Joseph C. Beck asked how many of these cases Dr. Stein had found in the literature.

Dr. J. Holinger asked whether the sublingual salivary glands were implicated, did they discharge any saliva, or were they obstructed.

Dr. Robert Sonnenschein asked whether the cyst contained any hair.

Dr. Stein, in replying to Dr. Beck, stated he had not gone into the literature of the subject. Dermoids of the mouth were not un-

common. This was the second one he had seen; the other one was not of this type. This one contained only sebaceous material and had no connection with any salivary mucous gland.

These growths belonged to the class known as teratomas. They were a well known class of tumors, in which there was a wandering of epithelial tissue from its normal source or residence. They wandered sometimes in early fetal life and became included in other tissues, as in this case. Frequently they were pinched or squeezed off in the development of the fetus, and when the cleft closed they remained as a common condition in various parts of the body, without anything happening, but when they developed, as in this case, there was tissue according to the elements present in the particular rests that had wandered or were pinched off. In this case evidently a piece of the ectoderm of the fetus was extruded or was caught within the submaxillary cleft (this being the particular cleft that made up both sides of the tongue) and here later developed. These dermoids are usually congenital growths. The epithelial tissue in this case contained sebaceous elements that developed later on and formed the sebaceous material. The cyst grew until it could not grow any further. Dr. Stein recalled seeing the picture of a case in Senn's book on tumors that contained something like two or three pints of sebaceous material. The patient was an East Indian negro with a large mass protruding from his mouth. The cyst developed in the floor of the mouth, protruded from the mouth and when operated upon contained nothing but sebaceous material. If some of the epithelial elements contained mucous glands, hair follicles or fatty tissue, or any of the elements of the skin, they were liable to develop also in this tissue until there was almost the development of normal tissue. A certain kind of dermoid could develop where all the elements were present, resulting in the formation of various degrees of monstrosities.

There are several types of this growth. One, a simple teratoma made up of the normal stratified epithelial cells. Another contains various elements of the skin, hair follicles, sweat glands, sebaceous glands, mucous glands, and some fatty tissue. In the same way the mesoderm may develop in the ectodermal or endodermal area and produce a teratoma there.

An interesting point was the matter of diagnosis. When one looked into the mouth and saw a mass of this character he thought of several things, probably a mucous cyst, a ranula, or an occlusion of a salivary duct. Usually they were one-sided, but this was absolutely in the midline, both sides of the tongue having been lifted up. In the region below the chin one could press the floor of the mouth down and the mass would protrude in the neck.

The patient felt this cyst when a child six or seven years of age. It gradually grew until last year it bothered her a great deal, was painful and became objectionable.

Dr. G. W. Boot demonstrated a case of brain abscess.

The patient was a man, aged 24 years, who fell from a high chair when nine months old and had a hemorrhage from the right ear, with continuous discharge since that time. He served in the Army for two years.

August 27, 1920, he entered the Presbyterian Hospital with an otitis externa. The abscess was opened and the patient went home

the following day. September 4th he returned complaining of headache, dizziness, nausea and vomiting, stiffness of the neck and a slight earache. He was slightly delirious and constipated. A spinal puncture revealed a cloudy fluid, with 6,250 cells; small diplococcus questionable. The cultures remained sterile after seventy-two hours. He was seen on September 5, and a diagnosis of meningitis secondary to a chronic discharge of the ear was made. A mastoid operation was performed and a large cholesteatomatous mass was found in the left antrum. The tegmen seemed softened; the dura was incised and clear fluid found. The temporosphenoidal lobe was incised and a thin, grayish turbid fluid with broken down brain tissue escaped. A drainage tube was inserted after the sinus had been exposed and found normal; the wound was tamponed. The patient had a stormy convalescence until September 19th; on the 21st, sixteen days after the first operation, a probe was passed up the path of the drainage tube and thick pus was removed, which contained colon bacilli and pneumococcus on culture. After that the headache disappeared, the patient felt fine and only complained that he could not go home. On September 26th he was permitted to go home, as there was no longer any drainage and the wound was granulating nicely.

The temperature before the operation was 101.8° F., at operation 100°, and most of the time was subnormal up to the time of the drainage.

The case was presented at this time because the otologists are divided as to the advisability of operating on these cases. One group said one should not operate on meningitis, another said not to operate on a brain abscess in the initiatory stage or in the terminal stage. This patient in the beginning stage of brain abscess had been operated. Dr. Boot had repeatedly operated on patients in that stage and they recovered. He felt sure the attitude taken by the men at the Mayo clinic was wrong—just like the men who said not to operate on the appendix until there was a well walled off abscess. He had now operated upon eight temporosphenoidal abscess and had four recoveries and had operated on three cerebellar abscesses, with one recovery.

Dr. Jerome F. Strauss presented his membership thesis entitled:

Accidents in Aural Paracentesis.*

DISCUSSION.

Dr. Otto Stein said that the paper of Dr. Strauss was very timely, and he did not think one could lay too much stress on the possibility of a hemorrhage occurring in any case of incision of the drum membrane. It was almost an axiom with teachers in otology to impress students. He knew that in postgraduate teaching they impressed upon physicians who were learning otology the greater care needed in the incision of the drum membrane on account of the possibility of finding anomalous conditions in the floor of the middle ear. Such cases had been reported from time to time, and those who were experienced in otology were constantly on the lookout for such a possibility. Therefore, this paper was of extreme interest at any time, in emphasizing the care one should exercise

* See page 232.

in performing the operation of incision of the drum membrane. This condition of the floor of the middle ear, where there was no bone proper and the jugular bulb presented prominently, was more commonly found in children in whom there was an acute condition of the middle ear.

Dr. Stein was particularly interested in the arterial type of hemorrhage. Venous hemorrhages could be readily detected and recognized on account of the character of the blood escaping, but the arterial cases were far more rare. He had presented to the society a case of an anomalous arterial vessel in the anteroinferior wall of the middle ear. The case was studied by several gentlemen and carefully gone over by the members at that time, and had been seen by the speaker frequently. He could not determine exactly from the X-ray pictures whether this was a case of anomaly of the internal carotid artery, or a branch of some large arterial vessel in the anteroinferior part of the middle ear. The patient had a suppurating ear for some time before it healed. He had some loose connective tissue which formed a fair drum, but this drum bulged forward, and there was a distinct pulsation which was controlled by the blood pressure in the neck. He applied for relief from an annoying pulsating tinnitus. All this, taken with the X-ray findings, showed it to be one of the arterial cases. He did not attempt to puncture the swelling.

There was another class of cases, that did not come under this heading, where there was a terrific hemorrhage from cutting, and this was where there was a malignant growth in behind. Of course, there was destruction of part or all of the drum at the time, but in incising or curetting this mass at the bottom through the canal alarming hemorrhage might take place from the erosion the growth had produced around the carotid artery, with severe hemorrhage following.

Dr. Joseph C. Beck stated that this paper brought to his attention the thesis he wrote on the only case on record, so far as he knew, of primary actinomycosis of the middle ear. He had observed the case in the Allgemeiner Krankenhaus in Prague from the beginning. The patient came in with the diagnosis of otitis media. Subsequently Dr. Hektoen of this city and the speaker worked on it from a pathologic point of view, examining the yellow bodies that were discharging from the mastoid wound, which proved to be actinomyces. This case progressed and terminated in a fatal hemorrhage from the ear.

The remarks made by the previous speaker with reference to erosion from growths were also applicable to his case for erosion from osteitis of actinomycotic origin followed. A postmortem examination was made, and they studied the temporal bone, which was excised and made serial sections of it, especially in the vicinity of the ruptured internal carotid artery, which was from an erosion caused by the actinomycotic process. The erosion occurred in the carotid canal and just at its relation to the eustachian tube.

The point in this case was the treatment of the hemorrhage. The patient did not die from the immediate hemorrhage that occurred from the ear. He was not able to control the hemorrhage from the eustachian tube. It was necessary to do a ligation of the carotid; then the patient lived for a little while longer, but it was the tremendous loss of blood at the time of the first hemorrhage that killed the patient.

In another case of an endothelioma, of the endovascular type, of the middle ear, one did not expect a great deal of hemorrhage on account of this tumor developing within a vessel. But Werner in his surgical pathology showed the fallacy of this thing in bleeding tumors. The speaker had a great deal of difficulty in treating the case and in dealing with the hemorrhage from the ear. It was not always possible to control this by packing, even though one had a firm canal. In this case, too, the blood went into the mouth, the lady expectorating large quantities of blood. It finally was necessary to ligate the common carotid. She was still living, although with marked facial paralysis. The endothelioma had not recurred, when he heard from her about six weeks ago.

Another point should be considered: If one accidentally opened the sinus and knew he probably had an infection pouring in from the suppurating ear, would it not be safer to shut off the general circulation, both cerebral and in the neck? In a case of that kind threatened with pyemia, Dr. Beck would rather do a ligation and pack off the lateral sinuses than to let the case go along and take chances, providing the patient was at all safe for such procedure.

Dr. J. Holinger said that he was of the impression that cases of hemorrhage after paracentesis were not quite as rare, and mentioned a case in the Chicago Eye and Ear Infirmary. It occurred in the year 1901 or 1902, when in making a paracentesis the knife of a colleague struck the jugular bulb which was protruding abnormally from below into the middle ear. Since there are usually anatomic abnormalities which give rise to hemorrhage, he called the author's attention to the fact that in 1899 at the International Otological Congress, held in London, Dr. Rohrer, of Zurich, showed a picture of a drumhead with a number of ectatic veins in the upper part, and described it as a blue drum membrane. They might have given rise to hemorrhages if an incision had been found necessary. This hemorrhage would have occurred in the upper part of the membrane, while hemorrhages from protruding bulbs of jugular vein occur in the lower part. In the normal membrane the bulb appears as a bluish cupola through the transparent gray membrane, but in inflammations, when the membrane is red and swollen, there is no possibility of recognizing the abnormality of a protruding jugular bulb in making a paracentesis in an acutely inflamed drum membrane.

Dr. George W. Boot read a paper entitled:

"Abscess of the Frontal Lobe Secondary to Sinus Infection."

DISCUSSION.

Dr. Sonnenschein stated that about four and a half years ago he had an unfortunate experience in the case of a medical student who developed a very acute right frontal sinusitis. Within twenty-four hours from the onset of the pain he had a tremendous edema of the eyelid, and despite the use of ordinary measures for two or three days, pain and swelling did not subside, nor did the temperature.

The anterior tip of the middle turbinate was then removed and a large quantity of pus evacuated. The symptoms did not improve. He then took the patient to the Michael Reese Hospital, and Dr.

Frank and himself opened the sinus externally and found a good deal of pus which was drained. The patient recovered and reached the point where he expected to go home the following day, but on that day he had a chill and the temperature rose to almost 106° F. Spinal puncture was made twenty-four hours later and turbid fluid found. A neurologist in consultation suggested frontal lobe abscess. They then opened the wound and explored the posterior wall of the sinus, but found no dehiscence and no necrosis. They removed the posterior wall and put a trocar into the frontal lobe and a large quantity of pus escaped. The patient, unfortunately, died. Whether the infection spread through small veins he did not know, but no macroscopic lesion was present.

Dr. G. Henry Mundt stated that in conversation with Dr. Boot he had told him of the most spectacular case of frontal lobe abscess he had ever had. Five or six years ago he did an intranasal operation on a young man, seventeen years of age, for a frontal sinusitis. The case apparently cleared up. Some months afterward he presented himself and was again having symptoms. He had a roentgenogram taken at this time, and the roentgenologist stated there was some osteomyelitis in the frontal sinus. An external operation was advised but refused. The patient got into the hands of some other practitioner, and eventually, when Dr. Mundt saw the boy, in company with two general practitioners, he had paralysis of respiration. He was kept alive for two or three hours with the pulmotor until his fingers and toes got cold. This boy was walking about the street six or eight hours before had this attack. He had eaten dinner in the evening at 6 o'clock and the paralysis of respiration came on about 7 o'clock. The patient died, and immediate postmortem revealed from four to six ounces of pus in a frontal lobe abscess. There were no symptoms previously that were referable to the frontal lobe abscess.

Dr. Joseph C. Beck asked whether the ventricles were opened in the postmortem examination.

Dr. Mundt replied that he could not recall whether they were or not.

Dr. Alfred Lewy asked Dr. Boot if he had observed in the patient with frontal lobe abscess any focal symptoms or anything that could be classed as focal symptoms of the mouth, movement of the tongue, jaw or lips.

He had seen two frontal lobe abscesses, one of which had as the only socalled focal symptom a licking movement with the tongue. The tongue was constantly protruding in licking the mouth. That patient was practically comatose. He did not recall the particulars of this first case, which was seen several years ago.

The second patient was a male child, four years of age, who entered the Eye and Ear Infirmary with an orbital abscess and was transferred from the eye department to the nose and throat division, and one of the men operated by the external route. The speaker was present at the first operation. An incision was made in the eyebrow and the orbit entered; the abscess was subperiosteal on the nasal side of the orbit. The periosteum was incised and pus lying between the lamina papyracea and the orbital periosteum was released. The lamina papyracea and for a distance behind was

necrotic, so that the operator curetted out what he could find of the ethmoid cells. The child apparently made a perfect recovery. The eye went back into place, the wound healed, leaving a good looking pale scar, and for several weeks the child stayed well. Then he was brought back and entered the speaker's service complaining of headache and vomiting. There was an occasional rise of temperature. The eye grounds, when the patient first entered, were doubtful, but the next day the eye men agreed there was some beginning choked disc. The patient was gone over for several days by a neurologist, who failed to detect any focal symptoms which would locate an intracranial lesion. There were no focal symptoms except a constant chewing movement. Spinal puncture showed 52 cells, the majority of which were polynuclears. The fluid was under slight pressure. The speaker operated upon the child in the presence of Dr. Sonnenschein, who helped him with his advice. An incision was made above the eyebrow and the bone removed. A number of X-ray plates indicated there was no frontal sinus, and no frontal sinus was found at the operation. He removed the bone, exploring the orbital ridge, and found the dura bulging but pulsating and practically normal. At one part of the dura there were a few spots, pinhead in size, that looked like granulations. The dura was incised and the brain tissue began to exude. The patient had extensive encephalitis. The speaker then went in with Gifford's searcher, and it entered the tissue of its own weight to a distance of two and three-quarters inches. He struck something that offered resistance and did not know whether he was against the wall of the ventricle or abscess cavity wall, but the child was in such a desperate condition he thought he had better take a chance. He perforated the abscess wall and got thick yellow pus. A rubber tube drain was inserted, which was later changed to glass. The headaches were immediately relieved, vomiting stopped, and the patient apparently did well for about five days. On the fifth night the child tore off the dressing, pulled out the drainage tube, and when he saw him there was a marked hernia of the brain but the child was not unconscious. As nearly as he could learn, the child had complained of headaches for the first time since the operation just before he tore off the bandage. The child lived three weeks: was fully conscious and perfectly bright in every respect up to five days before operation, and even with the headache, vomiting and choked disc his mentality was not disturbed. The only symptom that might be construed as focal was the chewing motion, and he wondered whether this was of any clinical value.

Dr. Joseph C. Beck thought the report of Dr. Boot should be criticised because it was not complete. He had left out a good many things that the members would like to know more about. Very little was known thus far about the functions of the frontal lobe.

Schaefer had called attention to some of these cases in reference to the olfactory function and had pointed out that in unilateral involvement of the frontal lobe there were frequently demonstrable changes in the olfaction. There was parosmia or symptoms of disturbed function of the sense of smell. There was not a loss of the sense of smell, but rather an irritation and an abnormal interpretation of odors. This was an early symptom.

The members ought also to have been shown the X-ray picture

of the case to determine whether there was really an absence of the frontal sinus. If he found it at the operation, Dr. Beck thought, no matter how much it was involved in the process of necrosis or filled up with pus, a good X-ray plate of one side of the nose or on the other side of the sinus would show some indication of a frontal sinus.

The blood picture given of 4,000 and some odd leukocytes without any differential count was another thing which was not clear. Assuming the patient was in a very bad condition, septic, run down, and had leucopenia, the differential count would have clarified the point as to whether there was a deficiency in the polymorphonuclear cells, or what was the cause.

Another point: The doctor said he had incised the subperiosteal abscess, yet there was no statement made as to an examination to determine whether the turbinates were cut. This was an important point to determine. While the patient was relieved after an intranasal operation, might not this patient have had an acute exacerbation if an old abscess due to a chronic condition?

The speaker's experience with cases of frontal lobe abscess was limited to about twenty, on which he had operated, but of this number there was only one of the real brain abscess cases that survived operation.

As to the prognosis of frontal lobe abscess in contradistinction to brain abscess from the middle ear, Dr. Beck believed the circulation had something to do with it.

In reference to the central vein that went through the foramen cecum and the longitudinal sinus, with distribution of the circulation at this point, it was a venous circulation. This point was never referred to very clearly by anyone in reports of frontal lobe abscesses.

A thing that had impressed the speaker in connection with these brain abscesses was the anatomic formation of the anterior horn of the lateral ventricle, which was so close to the frontal lobe that infection could readily take place in such a case as Dr. Boot had reported. The speaker had had such an experience. A patient, who had felt perfectly well one week previously presented symptoms of frontal lobe abscess which soon resulted fatally. At the postmortem examination a complete section of the brain was made, which showed perforation into the ventricle with a sudden increase in pressure on the vital centers, and this would give the symptoms Dr. Boot had described.

Dr. J. Holinger was impressed with the progress of the suppuration through the diploe and stated that this was not a very exceptional finding in the author's experience. It was not rare in a case of empyema of the frontal sinus for the pus not to show itself at the point where one might expect to find it. He observed in the mastoid as well as in the frontal sinus that the pus may spread in the diploe and appear in very unexpected places either below the skin or in the skull cavity. He recalled one patient, a girl, who complained of indefinite symptoms until one night she cried out and in the morning was found unconscious. Before that she was able to go out and play with other children. When he saw her, she showed a decided reaction on pressure over the frontal sinus on the left side. He operated from the outside at once and fol-

lowed the pus along the diploe and was led to an abscess in the temporal lobe six or seven cm. away from the frontal sinus. The spreading of pus in the diploe around the mastoid is more frequent, especially in traumatic mastoiditis. In one such patient he had to uncover in four successive operations a large part of the inner plate of the occipital bone till past the middle line, where an emissary vein led the thromboses to very near the torcular. The suppuration spread in the diploe after each operation, but finally stopped and the patient recovered.

Dr. Boot, in closing the discussion, said he would not expect in lesions of the frontal lobe to find focal symptoms except of a mental nature, and in the case he had reported he had been unable to elicit them since the patient spoke only Bohemian and because of the short time the patient was under observation.

He was in hopes some member of the society might say something abo ut streptococcus infection. Not long ago at a meeting of this society the subject of streptococcus meningitis was brought up and the statement was made that streptococcus meningitis did not recover. Dr. Holinger had one such case at the County Hospital that Dr. Boot also saw that did recover. Sptertococci were found in the spinal fluid. The speaker also had a patient with abscess of the right temporosphenoidal lobe in which the lateral ventricle burst when the explorer was but half way through the cortex, and the cerebrospinal fluid was thrown out some eight inches. The fluid, which was of a greenish tint, was collected and smears made at once showing many short chains of streptococci. The abscess was evacuated and the patient did very well for a week or more and then became more and more sleeply, finally dying in coma. Apparently an encephalitis had developed. There were no further signs of brain abscess.

In the case reported in the paper the X-ray examination failed to show the presence of a frontal sinus, although one was found 2 cm. in diameter and .5 cm. deep, filled with pus. The skull was very thick.

In answer to Dr. Holinger's question, the pus was seen oozing through the bone when the pericranium had been elevated.

In answer to Dr. Lewy's question, there were no chewing motions or other focal signs until the tonic spasm of the left arm and hand developed.

In answer to Dr. Beck's criticism, the serious symptoms developed so rapidly when they did come that there was not time enough to get a Wassermann reaction or to do other things that one would like to do to get a complete report. It was a question of doing what was possible in time to give the patient a chance for his life by operating.

The reason why abscess of the frontal lobe secondary to sinus disease has a worse prognosis than temporosphenoidal abscess is because the diagnosis is not made early, because focal symptoms are late in developing. This case was reported to show how serious a case might become before definite localizing symptoms occurred and to urge the members of the society to operate early on cases of frontal sinus infection where things were not running smoothly, without waiting for localizing symyptoms. In other words, to do an exploratory operation.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Meeting of December 5, 1920.

THE PRESIDENT, DR. ALFRED LEWY, IN THE CHAIR.

Multiple Brain Tumor.

Dr. Joseph C. Beck showed a specimen of a brain from a case of multiple brain tumor. Many diagnoses had been made in the case by various neurologists who had seen the patient and made careful examinations, each of them having placed the lesion in a different part of the brain. When the patient was first seen by Dr. Beck, he diagnosed a frontal lobe abscess associated with frontal sinusitis. Operation being decided upon, Dr. Beck exposed the frontal sinus and found it full of thick pus and the lining membrane markedly thickened. The nasofrontal duct appeared completely blocked. Nowhere could there be found any fistula or atrium towards the brain.

Leaving the area entirely separate and going into the aseptic area corresponding to the frontal lobe region, he found a thickened dura coming on from the posterior or cerebral surface of the frontal sinus. Upon opening this dura no abscess was found intradurally or within the brain; there was nothing but the thickened dura, a piece of which he excised for subsequent microscopic study. After some time (five and one-half months) the patient succumbed to the disease. The symptoms during this period were exceedingly variable; there were tonic and clonic contractions of the feet which disappeared. and mental and cerebellar symptoms became more evident.

Necropsy, performed by Dr. Beck, showed that each of the diagnoses based on frontal symptoms was correct. He found many encapsulated tumors, some of which dropped out when the brain was sectioned after hardening. These tumors were found in the cerebrum as well as in the cerebellum, which accounted for the great variety of symptoms. At first Dr. Beck thought that the tumors were multiple syphilomas, but histologic sections showed that they were walled off eipthelial tumors—walled off carcinoma of the brain. Dr. Beck had never before known of this as a primary growth, but in the literature he found two cases, reported by Fraser, and one man in Spain (cited by Greenwood of England) reported seven cases. It was interesting to note that Lewis Fisher of Philadelphia, who saw the man, localized the lesion exactly corresponding to one of the lesions that were found postmortem.

Dr. Beck called attention to the method by which this specimen was imbedded in a block of paraffin, which made it very easy to display, and he thought it would preserve the sections well. (Fig. 1.).

Bezold's Abscess.

Dr. Beck also showed two cases of unusual mastoiditis. The first case was that of a man whose trouble first manifested itself in June.

1917, by earache in the right ear and dizziness. These symptoms continued for two or three weeks, the patient being unable to work; gradually the symptoms improved and the patient returned to work, but soon they returned, more marked than formerly, and he again went to bed. One morning he arose and found himself staggering to such an extent that he could not walk. A doctor was called, who applied hot water bottles to the head; this gave no relief and ice packs were then used. Later the patient was taken to DeKalb, where he consulted Dr. Smith, who, after a careful examination, including an X-ray of the head, diagnosed sinus disease. The physician who had formerly seen the patient declared that it was not a case of mastoid disease.

Two days after the diagnosis was made the patient was operated upon; after the operation he was told by the doctor that the mastoid cells were full of pus. The operation afforded no relief from the symptoms, and the wound continued to drain. In November the patient left the service of Dr. Smith and placed himself in the care of Dr. Thiele, who brought him to Dr. Beck.

Examination at that time showed a fistula behind the right auricle which was discharging pus, which proved to be of mixed culture. A probe followed the fistula down toward the neck, somewhat posteriorly. The patient complained of lack of motion of the neck, and examination revealed resistance to movements, though by persistence and patience it was found that almost all movements of the head and neck were possible. Examination of the ear revealed no evidence of any suppuration ever having existed. Tests showed the ear to be reduced to one-half of normal. The Weber was lateralized to the right and bone conduction was markedly increased The test of jumping back from the tips of the toes to strike the heels against the floor gave a suggestion of spinal caries.

The patient was kept under observation in the hospital for one week, during which time the vestibular apparatus was explored; all the reactions proved practically normal, as did also the symptoms referable to the cerebellum. X-ray pictures of the head and neck, with special reference to spondylitis, showed no evidence of any vertebral trouble. The temperature remained constantly normal; all laboratory tests proved negative. A diagnosis of osteomyelitis of the temporal bone finally was made and the patient was operated upon.

Operation revealed granulation tissue around the fistula, and upon its removal there was soft bone at the tip which appeared much like detritus. A continuous bleeding vein was encountered at the depth of the tip of the mastoid toward the neck; the bleeding was controlled by the use of surgical wax, and the incision was continued through the mastoid backwards and outwards toward the occiput, where a collection of pus was found between the occipital bone and vertebral column. The under surface of the occipital bone in the vicinity of the pus pocket was eroded, and it was scraped down almost to the dura, but the dura was not exposed. The wound was closed by bringing the flap back and sewing it in position. Drainage was established by means of a stab wound behind the incision. The drainage was continued for about two weeks, when a bismuth injection was made under considerable pressure. Immedi-

ately following this the patient felt something in the middle ear, which was assumed to be particles of bismuth escaping through aditus and antrum into the middle ear. There was a feeling of fullness in the ear about two weeks, when all symptoms began to subside. Aural inspection failed to reveal any foreign substance, and it was concluded that there was some secretion rather than bismuth in the middle ear. The wound healed and there had been no recurrence in three years, and the hearing was not affected. No spinal puncture was made, but it was concluded that the symptoms were irritative.

The second case was that of a man who had an acute otitis media, followed by a rapidly developing mastoiditis. He was first seen on May 12, 1920. A simple mastoid operation revealed no evidence of erosion or other necrosis in the region of the tip in the neck. He made an uneventful recovery, and in thirteen days was out of the hospital. The wound healed and the recovery was absolutely normal. Two or three weeks later there was slight swelling over the mastoid, which was opened and cleaned out and drainage instituted. The fistula continued and a larger exploration was made. Following down into the region of the occiput, they found destruction of bone, and upon exploring the sinus and dura at that point pus was found. The sinus had been thought of, but there were no symptoms referable to it. However, upon pushing back the tissues of the neck, pus exuded, but on pressure of the neck there was no pus. Drainage was continued for several weeks, but on pressing back the tissues of the neck small quantities of pus continued to escape. Afterward they made a still larger exploration and found that the pus ran much more forward than in the previous case, collecting close to the region of the external jugular.

Another operation was performed, going down to the neck and opening through the sinus to get at the infected area, which was cleaned out and drained. The patient made a good recovery and went along practically without temperature but the pus persisted. Later an incision was made through the clinoid muscle, which was followed down to the depths of the neck and the cavity cleaned out. This had not been done before because of fear of infection of the jugular wound. The patient had been perfectly well for four weeks.

Smears showed a mixed bacteria, diplococci predominating; cultures also showed a predominance of diplococci, both at the primary examination and subsequently. The Wassermann reaction was negative.

DISCUSSION.

Dr. C. H. Long asked Dr. Beck if he had gone in the first time posteriorly if he would have accomplished the same results.

Dr. Beck said that on going down the same as in the first case he found that the pus went forward and he could not go posteriorly, but had to go through the mastoid foramen, sacrificing the facial nerve, or go through the sinus in the way he did. It was impossible to reach it from the back and get the necrosis which he could see and feel. It was only by going through the sinus that he was able to reach it.

Dr. Edwin McGinnis showed a patient who had had

Double External Frontal Sinus Operations

following two intranasal operations.

The patient was a man who had a double frontal sinus infection, with an intranasal operation on both of them. The first operation was performed by Dr. Good eight years ago; at that time the anterior end of the middle turbinate was removed, and the anterior ethmoid cells were rasped forward. Dr. McGinnis had seen Dr. Good perform this operation several times, but thought he had not reached the frontal sinus in this case. The other side had been operated by the late Dr. Friedberg. In 1918 the patient entered the Presbyterian Hospital with severe frontal pain, and pain through the eye, but did not wish the intranasal operation again. All the landmarks were gone, so it was decided to do an external operation. They opened through the eyebrow and made a little peekhole through into the frontal sinus. The front wall of the sinus was one-fourth inch thick. On the floor of the frontal wall of the sinus there were two quite large polypi, one attached to the posterior and one to the anterior wall. The sinus was filled with pus. The polypi were removed, the base curetted and on going down gently into the nose, a couple of ethmoid cells were found that had not been touched by the first operation.

The other sinus was operated in August, 1920. An incision was made through the eyebrow, the brow elevated and a small opening made in the front wall. The case was interesting because all of the sinus lining was detached and the mucosa seemed about three-sixteenths of an inch thick.

The patient made a pretty good recovery with a freely movable scar; the discharge had cleared up and the nose was in about the same shape as before the operation. The Wassermann reaction was negative with both blood and spinal fluid.

DISCUSSION.

Dr. E. P. Norcross asked whether Dr. McGinnis operated through the peekhole or whether he enlarged the opening.

Dr. McGinnis replied that he did a modified Lothrop operation, butting up through the nose. He had never been able to use the burr successfully through the nose because it seemed to tear things so much. The septum was not removed in this case.

Dr. Walter H. Theobald presented a thesis entitled

"A Radical Treatment for Chronic Suppuration of the Antrum with Modification of the Canfield Technic for Operation."*

DISCUSSION.

Dr. Joseph C. Beck said he was much pleased to see an operation illustrated which he had been doing for some time. He though he got it from Pierce or Skillern, and had published it in Ochsner's book on diagnosis, both the posterior incision and turning the flap over, not taking out but raising the flap toward the septum. He

*See page 131.

called it the "Skillern operation" because Skillern had the opening through the pyriform fossa, but later gave it up because it was too irritating. Dr. Beck used the electric burr, doing the operation very quickly, and that gave more room to work with than the large nose instruments. It was not necessary to see, because after exposing the margin of the pyriform fossa one could bite it through. He had obtained more satisfactory results from this than from any other antrum procedure.

Dr. Beck congratulated Dr. Theobald on bringing up the subject and was glad to have heard his description, although he believed someone else had done it.

Dr. Norval H. Pierce thought that the matter of priority was always a small matter to argue about. He had been doing the operation Dr. Theobald described for over ten years. It was founded on the Denker idea, the natural suggestion that would come to one's mind—could we not do away with the buccal incision? When that thought came to his mind he made the incision through the pyriform crest, and found that by reflecting the facial soft parts and lateral wall of the nose one could get an ample view of all parts of the antrum. He thought it rather an original idea to not sacrifice the inferior turbinate. He was not sure whether it was quite the right thing to do in all cases. He believed it caused a more rapid contracture of the hole, but he had seen a number of cases that had returned after five years with an ample orifice in the inferior meatus, and the anterior fifth, which had been temporarily detached, had grown back into place. The operation certainly gave a complete view of the antrum with a minimum amount of destruction, and he considered it as corrective as any operation could be.

In regard to the tape being left in, this is most frequently due to the gauze tearing. In his opinion, it would be a good plan to measure the tape before putting it in and check it up after taking it out, as it was a very simple matter to leave a piece in, but it was a very unpleasant occurrence after the wound had practically healed and was rather small to have the discharge persist and the unpleasant odor continue. When such a thing occurred, it was pretty safe to say that the packing had been left in, and the best thing to do was to reopen the wound and remove it.

Dr. Robert Sonneschein said that he had asked Dr. Skillern about his operation some years ago and was told that he used it only in acute cases, and expected to use it only in acute cases where he wished to keep the antrum open for a few weeks. He did not make a flap. In the operation described by Dr. Theobald, a flap was made, and if it stayed in place it prevented closure of the wound.

Dr. Sonnenschein had had his own antrum operated upon by the essayist some time ago, and the work was very skillfully and almost pleasantly done, except for one feature—the use of the trephine. He was very glad that had been discarded, for when one felt the vibration as it struck the roots of the teeth it was very unpleasant. He felt that the rongeur method would be much more agreeable. His operation was very successful, and while sometimes infection occurred, a few irrigations caused it to subside. The only disagreeable feature remaining was some anesthesia of the teeth most adjacent to the antrum.

Dr. Sonnenschein congratulated Dr. Theobald on his thesis and upon his entrance into the society.

Dr. E. P. Norcross said that Dr. Skillern termed this operation the "preturbinal operation." As he remembered it, he described it to him as a modification of the Canfield operation, but said it was a much less radical procedure. Dr. Norcross had performed the operation several times and to him the most surprising thing was the thickness of the pyriform crest. In his opinion, the point that should be appreciated even more than the method of operation was the fact that all kinds of antra, having all kinds of pathology, had been cured by a comparatively simple operation. It did no harm to try this method first, and if after a time it did not cure the trouble there was no objection to doing a Caldwell-Luc or Denker operation. He had been more successful by removing the anterior tip of the turbinate, thus getting a more permanent opening. In the last year Dr. Norcross had seen a number of cases that had been operated by the Krause-Mikulicz operation, simply making a hole in the nasal wall. This had relieved the patients of all symptoms, and they had had no unpleasant symptoms following the operation, all of which went to show that too radical surgery on the antrum or any other part of the body was not always necessary to obtain the desired result.

Dr. Norcross thought the essayist was to be congratulated on having a series of forty cases that had been cured. That fact alone must bear out the practicability of the operation.

Dr. Charles M. Robertson thought this operation was a good one but that there are so many good operations for the antrum that one could not do any one in all cases.

There was one place in this operation that made trouble. When the anterior inner edge of the cavity was taken away it left a place where the cavity was covered by the soft tissues of the cheek, at which site granulations would occur, and, as the essayist said, he had to apply nitrate of silver during the first week, which showed a piling up of granulation tissue in the opening of the antrum. The soft tissues must be watched in all antral cases. Granulations in this place encroach on the opening and destroy the opening from the anterior end.

The operation Dr. Robertson had always advocated was a modified Caldwell-Luc with special features as to the meatal flap of mucous membrane. In going through on the buccal surface one could easily determine at a glance the position of the attachment of the inferior turbinate body, as it shows a bulge on the nasal wall extending from before backward and downward, corresponding to the attachment of the inferior turbinated bone. In the operation he advocated the wall of the inferior meatus was removed in its entirety down to the floor, leaving the floor of the antrum and the floor of the nose on a level so there would be no interference with drainage from the antrum.

The mucous membrane of the inferior meatus was not attacked until the bone had been completely removed and the edges of the wound smoothed. The nasal mucous membrane was then cut in the form of a letter X from before and upwards downward and backward and from below and forward, upward and backward, which created four flaps which were reflected into the antrum and

held in place by the pack which was introduced into the antrum. These flaps cover the edge of the bony wound and part of the anterior antral wall and no soft tissue comes into contact with the nasal wound.

Thus the edge of the wound into the nose is covered with mucous membrane which secures a permanent opening as large as at the time of operation. Dr. Robertson thought operating through the buccal cavity gave a most beautiful result, and affords a better view of every part of the antral cavity. He had operated in this way for eight or ten years and had measured the opening into the antral cavity afterward and found that the opening remained the same as at the completion of the operation. This operation gave the advantage of a cavity in which one could see, and if one desired to drain the sphenoid into the antrum through the posterior ethmoid cells, it could be done under direct inspection. The operation could be done just as quickly as the other, and the buccal wound was not objectionable, being at the gingivobuccal junction, which precluded gaping, and which closed in from three to four days.

Dr. Robertson considered the operation under discussion admirable, but wished to enter a protest against displacing the turbinate or cutting any off. In his opinion, this would be sufficient cause for perverted physiologic function of the inferior turbinate.

In case the inferior turbinate extended to the floor of the nose enough might be trimmed from its lower edge to allow a ventilation space of six to eight millimeters between the lower edge of the turbinate and the nasal floor.

Dr. Frank Brawley said that he had seen Dr. Pierce and Dr. Theobald perform this operation and had since done six of them himself. He believed it was the best procedure for the chronic antrum that he had ever tried. He had experienced no difficulty in the after healing in any of the six cases he had had. However, he had taken off the tip of the turbinate in every case, but would try refracting the turbinate in the future.

One point was important in order to get a clear field, and this was to be careful to make the incision over the pyriform crest in the mucosa. Before he had much experience he made the incision at the mucocutaneous junction and got a good deal of bleeding, which he had difficulty in controlling. It was just as easy to make the incision in the mucosa, and there was much better control. It had appealed to him particularly, because it was such a safe operation, so far as the lacrimal duct was concerned. There was no danger of injuring the lower end of the duct by this method.

Dr. Alfred Lewy stated that he had the pleasure of working in Sturmann's clinic in 1898 when he perfected his operation, and Sturmann was surprised to know that Canfield had already perfected the operation and published it. He thought Canfield beat Sturmann to the publication.

Several years ago Dr. Lewy saw Dr. Robertson perform his operation, which looked like a modification of the Caldwell-Luc. He did not remove the tip of the turbinate. He operated under general anesthesia, and Dr. Lewy thought it took exquisite skill to peel off the bone from the membrane as he did. The unusual skill required

would probably prevent Dr. Robertson's technic from becoming popular.

Dr. Walter H. Theobald (closing the discussion) thanked the members for their discussion, and stated that in the first fifteen or twenty cases he used the electric driven trephine or drill, but found it to be a great discomfort to the patient. It was as disagreeable as having one's teeth drilled, so he discontinued using it.

The operation mentioned by Dr. Beck as the Skillern, the writer assumed was used only in acute cases.

Dr. Theobald believed Dr. Robertson would have some difficulty in keeping his flaps in place. The operations which the writer had reported were of the intranasal type. Canfield claimed priority for this operation in that his publication preceded Dr. Sturmann's of Berlin by two months.

As to the after-treatment, it consisted largely in controlling the granulation tissue which formed so rapidly around the first incision. After the packing was removed he irrigated the antrum through the canula until the secretion subsided, which usually took about ten days. The patient came in for irrigation a week later and perhaps two weeks later for further irrigation. For this purpose he usually used an astringent solution of cupric sulphate in dilution, about 1:6,000.

Dr. Edwin McGinnis read a paper on

"Problems in Bronchoscopy and Esophagoscopy"

illustrated with lantern slides.

Dr. McGinnis presented graphically some of the phases of this large subject and showed examples of the place of arrest of foreign bodies in the esophagus.

Case 1.—Child, 9 months old. Open safety pin resting in the laryngopharynx with the points upward and ring wedged in the introitus esophagi. It had been in this position for two weeks and was removed by turning and extraction with direct laryngoscope.

Cases 2 to 8 were coins and telephone slugs in the esophagus either at the introitus or further down at the sternoclavicular notch. Removed by means of direct vision.

Case 8.—Ring from an alarm clock lodged in the esophagus at level of the sternoclavicular notch. Three previous attempts at removal were unsuccessful. By means of fluoroscopic esophagoscopy it was removed and the child recovered.

Case 9.—Lead horse's head, prize from popcorn package, lodged in upper end of the esophagus. Kindly referred by Dr. H. R. Boettcher. Removed under direct vision.

Case 10.—Child with dorsal Pott's disease. Penny lodged at cardia. Passage of esophagoscope set up peristalsis, and penny could be seen passing through into the stomach.

BRONCHOSCOPIC CASES.

Case 1.—Upholsterer's tack in right bronchus of child 3 years of age, which had been in position six weeks. X-ray revealed tack. Removed fluoroscopically by means of upper bronchoscopy. Uneventful recovery.

Case 2.—Kindly referred by Dr. Harry Pollock. Six penny nail in left bronchus of child 20 months old. Nail had been in position for about six months. Fluoroscopically removed nail from bronchus, but point stuck into larynx and it was necessary to do a thyrotomy to remove nail tracheotomy. This child died one week later from a pneumonia.

Case 3.—Upholsterer's tack right bronchus of an adult aged 33. Removed fluoroscopically. Uneventful recovery.

Case 4.—Rubber in right bronchus. Child. Kindly referred by Dr. Joseph Beck. Lung on the same side appeared of greater density than the other lung on X-ray plate. Removed fluoroscopically. Recovery uneventful.

Case 5.—Patient, aged 43 years. Referred by Dr. Oliver of Chicago. Six weeks previously had had fourteen teeth extracted with nitrous oxid gas anesthesia. Was normal for about two weeks and then began to cough. One week later pain appeared in the right chest, and X-ray showed foreign body in right bronchus. Removed fluoroscopically and was found to be part of a molar tooth. On looking again another object presented itself. This proved to be an amalgam filling and was removed. Recovery was uneventful.

Case 6.—Watermelon seed in the right bronchus of an infant of 8 months. Faint shadow on the X-ray plate. Removed by upper bronchoscopy. Recovery uneventful.

Case 7.—G. J., age 5, seen November 8, 1918. In the morning the child was eating some raw carrot; with a sudden sharp intake of breath, she was seized with a violent fit of coughing which persisted for some time. She became hoarse and decidedly wheezy. On admittance to the hospital, breathing was slightly accelerated. Examination: Right lung, increased breath sounds, bronchial breathing with wheezing rales anteriorly. Left lung, absence of breath sounds, no area of dullness.

November 8, 1918, at 8 p. m., at Presbyterian Hospital, without anesthetic, upper bronchoscopy. The larynx and upper part of the trachea were clear; at bifurcation and extending into left bronchus several small yellowish objects were seen. These were removed with forceps, there being two large pieces of carrot, about the size of a small pea, with several smaller pieces in a great quantity of mucus. The patient left the operating room in good condition. At 11:05 the examination revealed air going into both lungs and considerable roughening of breath sounds. Four days afterwards the temperature went up to 103.6°, but the next day dropped to normal. She left the hospital November 13, 1918. Her mother wrote that she had pneumonia afterwards and coughed up a little piece of carrot.

Case 8.—L. H., aged 1 year, referred by Dr. A. E. Loewy. Three days before admittance, or on June 9, 1920, the baby was eating a hard boiled egg and some of the eggshell became lodged in the larynx. This produced difficulty in respiration which gradually became worse. At the time of entrance into the hospital there was marked retraction of the sternum with each respiration, as well as marked movement of the lower ribs. The feet were becoming cyanotic. The child acted like one with laryngeal diphtheria in need of intubation.

Coarse rales could be heard all over the chest in front and behind. On June 12, 1920, at the Presbyterian Hospital, by direct laryngeal examination could see a piece of eggshell in the larynx anteroposteriorly between the cords. This broke up into little pieces under the grasp of the forceps. Breathing was not much better after this, so a tracheotomy was performed under local anesthesia. Upon opening the trachea, some eggshell presented in the wound and this was removed. Breathing was better with the tube in place.

Temperature at the time of the operation: 102.6 degrees; June 13, 102; June 14, 103.2; June 17, 99.6; June 18, 103.

On June 17th the tracheotomy tube was removed for cleansing and the patient had great difficulty in breathing until the tube was replaced. On June 18, 1920, at 4:25 a. m., the child died gasping for air.

Postmortem examination: Beginning just at the lower edge of the tracheotomy opening was a large fibrinous exudate almost filling the lower trachea and extending down into the bronchi at the bifurcation, which was the cause of death. No diphtheria organisms were found.

Case 9.—H. H., aged 3 years, referred by Dr. John E. Rhodes. On September 22, 1920, the patient's parents noticed the boy playing with some acorns. A short time later they found him in a fit of coughing, and becoming quite blue, breathing rapidly and with great difficulty. In a short time breathing became better and the color became normal. When first seen by Dr. McGinnis on September 12, 1920, he had been having asthmatic attacks for six or seven months. Upon X-ray examination, the upper lobe appeared to be more dense. No shadow of a foreign body was seen. Direct laryngoscopic examination revealed something coming into the larynx and receding with inspiration and expiration. It was grasped with a forceps but could not be extracted. Then it disappeared and a good deal of secretion was coughed out. Upon insertion of the bronchoscope some obstruction was noted, but careful search failed to reveal any foreign body in the bronchus.

An intubation tube was inserted, which was remvoed the next day. In one week another examination revealed a swelling of the right side of the subglottic space. The child became cyanotic and a tracheotomy was performed. The incision opened up a large peritracheal abscess, probably due to a broken down cervical gland. The child improved and was sent home with the tracheotomy tube in place.

In conclusion, Dr. McGinnis said that these cases now have an earlier diagnosis and are in better shape for operation. His early experience in the practice of the late Dr. Ingals was discouraging in that the foreign bodies remained so long unrecognized. There was usually abscess formation and extraction was almost impossible.

DISCUSSION.

Dr. George W. Boot congratulated Dr. McGinnis on his success in this very difficult kind of work. In his opinion, no work is quite so difficult as removing foreign bodies from the bronchi and esophagus. He was surprised to know that Dr. Ingals had not had more

foreign bodies to remove than Dr. McGinnis reported. Dr. Ingals' finder was altogether different from Dr. Boot's, as his has only one turn, and the end, and Dr. Boot's was a regular corkscrew, so that by rotating it the point of the open safety pin was brought within the spiral and protected in such a way that the safety pin could be extracted without tearing the mucosa.

There was one point in which he did not agree with Dr. McGinnis: he thought no one should ever search blindly for these foreign bodies. Wherever possible, the foreign body should first be seen before attempting to grasp it. He very recently had an experience with a foreign body, which was a little different from the usual. The patient was a child of 18 months, who had inhaled a piece of carrot and the family physician had tried to extract it. The child was taken to the hospital and an interne tried to remove it and the piece of carrot turned and shut off the breathing. The intern did a hurried tracheotomy and then Dr. Boot was called. He found it impossible to use a suspension apparatus and then the bronchoscope as he ordinarily did because of the tracheotomy tube's being in place, but he finally located the foreign body and removed it.

He thought it was surprising how many of the patients swallowed coins. He once had a colored servant maid who stole her mistress' jewelry and swallowed a diamond ring. By the time he reached the patient the foreign body had passed into the stomach and out of his territory. The hospital people were going to do a gastroenterostomy, but Dr. Boot told them to wait for a while, so two policemen were kept on guard, and in two or three days the patient passed the ring.

Dr. Otto J. Stein has been interested in this subject since the inception of the work, and in the spatula which Kirstein first brought out, which he had used very persistently in his work. He then became very enthusiastic about the work with the bube, as brought out by Killian, and thought it was remarkable how much success one could obtain in patients with real pathologic lesions within the esophagus or tracheobronchial tract, as well as in finding foreign bodies if one gave a lot of time to it and allowed others to know they were doing the work.

A number of years ago there was difficulty in finding such patients to work upon. After realizing that he never would become an expert, he almost dropped the work and found that by unanimous consent this particularly difficult work of scoping really belonged in the hands of only one or two who were especially interested and who had the peculiar ability to apply their skill. It seemed to be the unanimous opinion that the work should be in the hands of Dr. Friedberg. Aside from the foreign body extraction he used the tube work quite often as a means of diagnosis and in the treatment of tracheal ulcers and some years ago used it a good deal in bronchial asthma, thinking that by dilatation of the trachea some of these cases could be relieved, and it did bring relief in many cases.

Aside from the foreign body work there was a very definite field for this work. In making applications to ulcers in the trachea, in removing sections of tumors below the glottis and in the larynx, diagnosing stenosis in the esophagus and trachea, made the application of the method much broader than one ordinarily thought.

Dr. Stein believed every laryngologist should practice tubing, and it was now being taught at the Postgraduate Hospital. In that way it was possible to teach the hand and eye to locate different parts of the trachea by demonstrating that one could work bimanually. With the probe and forceps and measuring the distance, one did not have to do this very often before becoming accustomed to the localization of the parts, and the method was often of much assistance.

Dr. Harry L. Pollock referred to a case seen recently which was very interesting along this line. The patient was a man who had a tracheotomy performed in June. The surgeon who did this died within a few days afterward, and everyone was afraid to remove the tube. The patient was sent in to him with a history of having cleaned the tube with cotton wrapped about an applicator. He was cleaning it in this way one day, when suddenly the cotton and applicator disappeared down the trachea, and the patient stated that when he was sitting up it obstructed his breathing. He came in bending away forward, for in that position there was no obstruction. Dr. Pollock took out the tube and did a lower bronchoscopy, but could see no cotton or applicator, and decided that possibly the thing had gone upward, above the tube. If it had been below the tube, he felt that it would have dropped further down. The patient was breathing fairly comfortably lying on his abdomen and the following morning they suspended him. Examination showed complete edema which closed the entire larynx. The following day the tube was again removed, and when it was replaced again the patient said he could feel the applicator at the end of the tube. The tube was pulled out again and the cotton and applicator came out with it. He thought it had gone upward and when the tube was removed it permitted it to fall down.

Dr. Pollock said they had had a good many cases of foreign body removal, and he agreed with Dr. Boot that one should never search for them blindly. He believed that all the trouble in these cases came from laryngologists going down and grasping the membrane. He was certain that every such case that had been referred to them that had died, had died as the result of having the mucous membrane torn and infected. He recalled a case seen with Dr. Friedberg, in which the patient had swallowed a tack, and they could not find it. He used the fluoroscope and directed the tube the same as Dr. McGinnis showed in the nail case, but Dr. Friedberg could not get the tack either way. They could see several times that he was immediately over it, but he was unable to get it. Dr. Pollock thought that the fluoroscope, to be of the most service, should have two tubes, a lateral and an up and down, and that it was far better to go right down and see what was being done rather than depending on the fluoroscope.

Another case which had astonished him was that of a little child 2 years old, who had swallowed a quarter. They took an X-ray picture and found the quarter in the stomach, although he had thought that a quarter would not go through a child's esophagus. A neighbor had told the mother to give the child a big dose of castor oil and that same evening the child passed the quarter.

Dr. Norval H. Pierce said that lately he removed a sandbur from the larynx of a young woman after it had been in position for al-

most a week. The sandbur was situated in the anterior portion of the larynx, between the vocal cords. The patient, a young lady, was walking with some friends, and in going through the grass the sandbar had attached itself to her skirt. She had on a pair of mitts, and in removing the bur from her skirt it attached itself to the mitt and she attempted to remove it with her teeth, and in doing so she inhaled the sandbur. The remarkable thing about the case was that the patient had very little discomfort. There was no edema and little pain in the larynx and the bur was removed very easily. The patient went home in a day or two.

Dr. Edwin McGinnis (closing the discussion) thanked the members for their liberal discussion. He felt that there was one serious side to the question: if anyone wished to go into bronchoscopic work thinking to get rich, he would get badly fooled. Most of the people who get foreign bodies into the trachea and bronchus are the children who are not taken care of, and the parents are unable to pay very large fees. The instruments are very expensive. Those that Dr. Ingals had used were given to Dr. Friedberg and had now passed on to Dr. McBride. The remunerative side of the work was not great, but the patients came to the office, as they had done in the days of Dr. Ingals and Dr. Friedberg, and someone had to take care of them.

SOCIETY PROCEEDINGS.

ABSTRACT OF THE SCIENTIFIC PROCEEDINGS OF THE FORTY-SECOND ANNUAL CONGRESS OF THE AMERICAN LARYNGOLOGICAL ASSOCIATION, HELD AT BOSTON, MASS., MAY 27-29, 1920.

Reported by Emil Mayer, M. D., Abstract Editor.

President A. Lawrence Lowell, of Harvard University, delivered an address of welcome.

Looking at American professional men and comparing them with men of the same class in Europe, one is brought to the conclusion that the American specializes more and earlier than does the European. It takes men a longer time here to fit themselves for medicine than for other subjects, because the amount of material they have to command is very much greater. One looks forward to the time when a simplification will take place; when some particular form of information will make way for the advent of general principles that simplify the processes of education and which will permit of the command of a larger variety of facts than could be available through isolated factors. These processes occur from time to time. Thus the bacterial theory of disease has simplified a great many problems which otherwise would have remained separate and complex.

The whole process of medical education is interesting to one who sees it as part of the total plan of education for a large number of professions. In the other professions men are trained to be citizens as well as professional men, as for instance in the legal profession or in engineering. In medicine it is all the other way. Medicine is a field of specialists.

If it is true that there is a time for everything; a time to be born, a time to wed, and a time to die, and it is generally conceded to be a mistake to do any of these things at the wrong time, then it is especially true that there is a time to enter a profession. There is a period when men acquire knowledge more easily and launch out with more energy and force into their career. I feel that men today are entering too late, especially in medicine. The amount of preparation required could readily be extended so as to make it impossible for men to enter at all before forty years and then it would be useless. The entrance time now is nearly thirty, much older than in other countries.

Our education begins too late. Children are sent to school much later with us than in European countries. Two years are lost and are never made up. The speaker believes that boys are capable of commencing college life at sixteen. The mind is more active at twenty than at twenty-five. The war showed us that our boys could rise to anything that occasion required of them. The speaker then extended a very cordial welcome to Harvard University to the members of the association.

President's Address.

The President of the association, Dr. Norval H. Pierce, of Chicago, then addressed the association.

Attention was called to the history of the association and the high standard held to be requisite for membership.

If ever an esprit de corps existed among a body of men in the finest manner, it has existed in our association, but the speaker believes that we stand on the threshold of a new period in our development. In all the domains of human endeavor a great change is taking place in social, scientific and economic life. We will no longer be content with things as they were. There is a desire in the air for new and more productive effort, and that which interferes or tends to check the fulfillment of that desire will sooner or later be swept aside.

We must at all hazards widen the scope of those who practice within the confined limits of laryngology. First, by the preliminary education of specialists. (The speaker then quoted from a report by a committee composed of the heads of the departments of oto-laryngology of three universities in Chicago, of which he was a member.) Second, association with other branches of medicine. Third, investigation and research.

The speaker called attention to the danger of regarding the association as an elysium where effort ceases, and to this end suggested that the method of program preparation be radically altered by the formation of a program committee who shall hold office for a term of five years. He then declared the meeting open for the reading of scientific papers.

Retention Crypts in the Infratonsillar Nodules as Common and Extensive Harbors of Pathogenic Bacteria.

By THOMAS R. FRENCH, M. D., Brooklyn, N. Y.

Our especial attention was drawn to the infratonsillar nodules, in tonsilloscopic studies in situ of the inferior lobes of pathologic tonsils, including a few which had been permitted to remain after tonsillectomies. The tonsilloscope must, therefore, be regarded as the responsible agent in detecting and exposing those germ-laden menaces to health, for that little instrument of precision had led us to at least the beginning of a knowledge of common and often very extensive harbors of infectious material, which of necessity must be reckoned with.

This study deals only with the chains of nodules lying on the lateral walls of the pharynx and the base of the tongue, directly beneath the faucial tonsils.

In the first actual removal of nodular tissues, which was from the throat of a girl, seven years of age, a section a quarter of an inch in length was enucleated with the tonsil, and in that short tonsillar appendage three collections of pus-like debris were found. And in conjunction with that revelation, we were cheered by what seemed to be another, of only slightly less importance, that on the under surface of the appendage there was a smooth limiting membrane which was manifestly a section of a fibrous capsule. The double display was, naturally, quite sufficient to stimulate thought

for devising means to secure the removal of the whole of the structure, and when that had been accomplished and many entire nodular columns had been enucleated and their contents examined, it was made wholly apparent that here was a hidden, but probably common source of infection, which, no doubt, had been responsible for the inception and continuation of physical ills which had long baffled understanding. And it also was made clear that after we have become skilled in removing those masses of disordered tissue within the limits of safety to the patient, we will have no more right to permit such tissue to remain attached to the throat in our tonsil operations, than we now feel we have the right to perform a tonsillectomy, or even an incomplete tonsillectomy, when the tonsils are seen to be infiltrated with the products of past attacks of acute inflammation.

The pathologist reported that the removed nodules had well developed fibrous capsules and a few crypts but did not contain pus.

An examination of those specimens in the external tonsilloscope before they were sent to the laboratory, showed what we believed to be superficial abscesses, as each of the closely set collections of foreign material lying near the surface, was surrounded by a zone of hyperemia such as is always seen surrounding abscesses in other lymphoid tissues. Despite the position pronouncements of the tonsilloscope, we did not feel justified in continuing the removal of nodules until a solution of this vexing question could be found.

These examinations were made with the tonsilloscope, and also with a direct illumination of the nodules from a concentrated beam of an arc light, the field of observation meanwhile being magnified with a large warmed lens held in front of the mouth. While the nodules were glowing with the light of the tonsil lamp, or were being directly illuminated and magnified in the way just described, numerous small slits and pin-point spots, flush with the surfaces, were seen upon the tops of the lymphoid bodies. With the aid of a very thin bent probe, or searcher, those slits and spots were shown to be minute openings to crypts of varying sizes, but often relatively very large, and which at once were proved to be veritable traps to the unwary ingesta of secretions gravitating downward from the mouth and throat, for each of them was filled, and some of them were distended, with necrotic material which could easily be culled out with a curette. The constant presence of pathogenic bacteria in the crypts of the nodules has now, seemingly, been established, and those tissues, therefore, constitute still another field to which we must look for possible sources of chronic systemic infections.

OBSERVATIONS ON THE ANATOMY, PATHOLOGY AND BACTERIOLOGY OF THE NODULES.

Except in broken chains and in minute form the nodules are not present in a state of health. Their presence in continuous lines or solid columns is an expression of a pathologic state. The four tonsils are constant structures. The nodules are constant only in minute form, but the fields, or pathways, over which they may develop, almost as if they were new growths, are definitely mapped out. The extent to which those fields, or pathways, may be occu-

pied by the nodular tissues depends largely upon the amount of and the degree of irritation occasioned by the foreign material deposited within them.

The nodules are of a piece with the tonsils, as their underlying capsules are a continuation of the capsules of the tonsils. The mucous membrane covering the nodules is attached to the lower edges of the inferior poles of the tonsils, but the loosely attached ends of the lymphoid bodies extend upward to and occasionally slightly overlap the under surfaces of the posterior lateral halves of the inferior lobes.

It, therefore, would seem to be a fact that while in late childhood and youth, in association with diseased tonsils, there are always pharyngeal nodules which later may become branches, the lingual nodules are always branches, for they do not exist without trunks made by their junction with the pharyngeal nodules. The lingual branches are apparently developed in youth, and then only in association with extensively diseased tonsils.

Our observations lead us to the belief that the lingual tonsil is far less frequently enlarged than the nodules which connect it with the faucial tonsils, and when it is enlarged it is very much less so than the nodules. Indeed, it seems to be a fact that when the lingual tonsil is enlarged, and the associated nodules are connected with pus tonsils above, the nodules are apt to be several times larger than the lingual tonsil.

We believe that the free ends of the lingual branches are much more often the cause of pressure-cough in adults than is the lingual tonsil which is usually credited with it. This has occasionally been interestingly illustrated in the subjects of long standing irritative cough who were almost instantly relieved by the emptying of crypts in the nodular tissues which were lying in contact with the epiglottis.

Pus is not often found in the nodules. We have opened abscesses in several trunk specimens, but have not seen pus elsewhere in those structures. The necrotic tissue is practically all in the crypts, and in many of them it is so tightly locked in by the constricted mouths, that it seems almost as if it was sealed in, for in order to rupture such crypts in a fresh specimen it is necessary to apply heavy pressure to the sides of the nodules. As the lymphoid nodules described in this paper were believed to be devoid of lymph paths or crypts and also of capsules, objection has been made to their being classed as tonsils. Both of the missing links have been found to be cryptic, or in hiding, and as we now know that all the elements which characterize the faucial tonsils are, with a somewhat different arrangement and grouping, also present in the nodules, it would seem to be entirely correct to place them in the tonsil class. As they are in truth but offshoots or branches of the faucial tonsils, it may come to be a habit to speak of them as parts of the faucial tonsils, instead of separate structures. But future developments will affect their proper classification.

DIAGNOSIS.

By depressing the tongue far back upon its base the lingual branches and the upper parts of the nodular trunks will be directly exposed. The tonsil lamp is then made to slide along behind the

ridges of tissue to produce in its passage a luminous display of the pathologic conditions in every part of them. If, however, the fauces are too irritable even to permit the manipulation just described, then the condition in a nodule can, with a fair degree of accuracy, be determined by ascertaining the condition in its associated tonsil, for a situation in which the lamp cannot be quickly slipped behind a tonsil is scarcely conceivable. If the diseased condition of the tonsil is extensive enough to give a uniform bright rose-shade of color in transillumination, it is a fair assumption that in subjects above the age of six or eight years, filled retention crypts, varying in a general way in number and size according to the age of the subject and the extent of the disease in the tonsil, are present in its annexed nodule.

ENUCLEATION OF THE NODULES, PUNCTURE AND CURETTAGE.

The key to the method of enucleating the pharyngeal nodules at any age and the nodular trunks and their pharyngeal branches in adults, lies in a block molded to fit over the angle and under the lower edge of the jaw in such a way that it will serve as a resisting wall, or outside runway, for an undercutting scoop of the arc of the Sluder guillotine.

The block duty usually falls to the anesthetist. After the block-mold is in place, the forefinger of the free hand of the operator is introduced into the fauces to press the tonsil firmly outward and downward upon the nodule to be removed. The guillotine, with the flat surface of the shaft in a horizontal position, is then introduced obliquely into the mouth and dipped gently downward over the side of the base of the tongue, close to the end of the forefinger pressing upon the tonsil, until the arc meets with the resistance of the pharyngoepiglottic fold. The edge of the shaft is then pressed forward deeply into the base of the tongue as near its outer limit as possible. The arc is now pressed outward with moderate firmness in order to sink it into the tissues below the free end of the nodule, and, while maintaining the pressure of the shaft against the tongue, the arc is drawn slowly upward along the block-supported wall toward the finger pressing upon the tonsil.

Upon reaching the inferior pole the upward movement of the arc is checked and at the same instant it is pressed hard against the ramus of the jaw to maintain its hold upon the stretched mucous membrane of the lateral wall of the pharynx. That membrane is highly elastic and is drawn under the nodule in ridges, like the wake of a moving hull, and put under considerable strain as the lower end of the nodule is doubled under itself by the arc. The finger holding the tonsil is then slipped down to the dislocated nodule overhanging the arc, to manipulate it into the grip of the blade of the guillotine—when after a half minute of compression it is cut off and the guillotine withdrawn.

A pharyngeal nodule is removed after a tonsillectomy—the block-mold being in position outside of the neck—by a scoop of the arc of the guillotine upward against a resisting finger held in the lower part of the empty tonsillar fossa, where it also may be made to

assist in manipulating the dislocated tissues into the grip of the blade.

While enucleation of the lingual branches with their capsules is most appealing to our ideas of completeness, it is possible that a less thorough removal of them will be quite as effective in obliterating the retention crypts, and also that the resulting wound will be less liable to inflammatory reaction during the healing process. An incision from the free end to the trunk made midway between the capsule and the upper surface would, in a fully developed nodule, undercut many crypts and probably convert the remainder into more or less wide-mouthed cups which could never again entrap foreign material. A very promising plan of accomplishing the midway severance of those tissues is to shave off their tops with the guillotine, for with it the alignment is more accurately made, compression can be practiced, and, if the lymphoid masses are not drawn through the fenestrum of the instrument, there is no danger of wounding the subjacent tissues or the numerous small varices which in adults often overlap the bases of the nodules. In all the subjects operated upon for the removal of infratonsillar nodules, the somewhat surprising and altogether pleasing fact has been that the blood loss from that source during operations was negligible, apparently adding little or nothing to the drain of the tonsil and adenoid procedure, and also that there has been no postoperative hemorrhage, no deterrent effect upon recovery from the enlargement of the pharyngeal wound and no added pain during the healing process. Indeed, the clinical picture following tonsil and adenoid operations including the removal of the nodules, has been the same as the familiar picture after similar operations without the removal of nodules. The above statement is based upon a "follow up" of most of the patients from whom nodules were removed, but, of course, we are not yet in a position to determine whether there are to be late postoperative effects. The operations for the removal of nodules were all performed under general anesthesia while the patients were in both recumbent and upright positions. Much of the best results were obtained in the upright position, as the gravid tongue not only permitted an easier manipulation of its base but greatly broadened the operative field. We presume the nodules can be enucleated under local anesthesia, but a consideration of that feature of the subject has not yet been reached. Where operation is not performed, nearly perfect results can be obtained by puncture through the sides of the crypts and curettage of all nodular structures.

Skilful curettage is an art which requires considerable practice to acquire, but the value of the method as a conservative measure makes it worth the while to develop, if possible, the deftness needed for the procedure. For high walled, narrow topped, jellylike lingual branches, in which the crypts are long and their openings minute, an effective method of emptying the crypts is by compressing the nodules with an oval sponge-stick and then expressing the cryptic contents.

DISCUSSION OF DR. FRENCH'S PAPER.

Dr. D. Bryson Delavan, New York: This splendid contribution of Dr. French is the result of long continued, painstaking, exhaustive

work. It is presented not as a theory, but as a series of abundantly demonstrated scientific facts. It is a valuable addition to the established knowledge of the anatomy and pathology of the lymphoid elements of the lower pharynx. In the clearness and force of the presentation, the convincing character of the pathologic specimens exhibited and the beauty of the illustrations, the association has rarely received a contribution of equal merit. I have had the privilege of following Dr. French's investigations for a long while. The practical application of his ideas has proved their truthfulness and well established their value.

Dr. Greenfield Sluder, St. Louis, Mo.: Upon the introduction of Dr. French's tonsillescope, five or six years ago, I predicted that it had a future capable of great development. This work is the result of careful, painstaking and industrious investigation. The nodules spoken of seem to be in close proximity to the lingual mass and cross over behind the lingual fossa. In five or ten years these masses fill up and practically reproduce the entire tonsil.

Dr. Henry L. Swain, New Haven, Conn.: There are two or three points that I should like to make. The first is that we are told that all the new work is being done by the young men; but this wonderful piece of work is done by one of our oldest members. Another point is that this tissue is definitely encapsulated and mechanically loosens upon enucleation. As to the location of the nodes: I have been a little in doubt as to where they are located. It is not clear to me what the lateral column of the pharynx has to do with the situation, but we have to deal with groups of lymphoid tissue, which seems to be identical with the pharyngeal and lingual tonsil. This structure has the same ill effect upon the system as the tonsil and the importance of removal is equal in value to that of the tonsil in any other situation.

Dr. George L. Richards, Fall River, Mass.: I would like to express my personal thanks to Dr. French for this splendid contribution, coming as it does from one who has been a member of this association for forty-one years.

Dr. French, closing the discussion, expressed his appreciation of the gratifying and eloquent remarks on the paper by Dr. Delavan and Dr. Swain. He was glad to learn that the description of the nodules alone had been sufficient to enable Dr. Sluder readily to find an explanation of the recurrent tonsil or infiltrate, for, as with many other features contained in the body of the paper, that was not brought forward in the necessarily limited presentation of the subject. As to age, referred to by Dr. Richardson, the present outlook was that many more years must be added to his score before he could even begin to comprehend its existence.

An Unusual Type of Nasal Tuberculosis.

By DR. GEORGE E. SHAMBAUGH, Chicago, Ill.

Read by title.

A Case of Multiple Strictures of the Esophagus, Apparently Cured by Repeated Dilatation with Graduated Bougies.

By CLEMENT F. THEISEN, M. D., Albany, N. Y.

Female, aged 51, under care by the writer for eight months. She had been unable to swallow anything but liquids for the past year.

She had lost 28 pounds in weight and was markedly cachectic. She traced her difficulties to the accidental swallowing of a small amount of the fluid contained in a bottle of smelling salts, about two years ago.

The difficulty in swallowing became gradually worse until for the last year she could swallow only liquid food, and that often with difficulty.

Examination, both fluoroscopic and with X-ray plates, showed five distinct strictures, the first about the cricoid and the other four almost equal distances apart, the lowest about 2½ inches above the stomach.

After a period of rest a small, very flexible, metal bougie was passed through the first stricture. This was repeated several times before any attempt to pass through the others. She was able to take a little more liquid nourishment after the first few weeks. During the next six weeks the other strictures were successfully passed, the lowest one causing the greatest difficulty. Increasing sizes were used until an almost normal size could be introduced.

The patient gained rapidly, her weight became normal, and is able to take three full meals a day.

Dilatation was practiced every two weeks with fairly soft flexible fibre bougies.

The writer calls attention to the need of dilatation over a long period of time before it may be regarded as cured.

Report of a Case of Syphilis, Vincent's Angina and Sarcoma of the Pharynx, Following Each Other in the Order Named.

By CLEMENT F. THEISEN, M. D., Albany, N. Y.

Male, aged 38, had deep ulceration almost covering the surface of both tonsils. Wassermann was positive, syphilitic history not obtained. Iodid of potash given, but the ulcerative process extended.

Vincent's angina was now apparent, being confirmed by an examination of the smears. In spite of vigorous treatment, including salvarsan, the process extended.

He then developed a large very hard mass in the left side of the neck. A piece of the very firm nodular mass from the edges of the tonsillar ulceration was removed, and upon examination proved to be a round celled sarcoma.

Serious hemorrhages from eroded blood vessels took place. The nodular mass, which broke down rapidly, extended to the base of the tongue and finally into the larynx, and the patient died soon thereafter.

This case is reported because of the unusual combination of diseases; the writer believes this occurs more frequently than the records show.

DISCUSSIONS OF DR. THEISEN'S PAPER.

Dr. Francis R. Packard, Philadelphia, Pa.: I had a similar case to the second one reported by Dr. Theisen. It had been diagnosed as quinsy and there was an ulcer where the incision had been made. Wassermann was strongly positive, salvarsan was injected

and three weeks later the throat condition was very much worse. Removing a portion, the pathologist diagnosed it round celled sarcoma. Coley's fluid was given with beneficial results as far as the sarcoma was concerned.

Dr. James E. Logan, Kansas City, Mo.: I do not think it of any advantage to the patient to administer salvarsan without being absolutely certain of the specific nature of the lesion.

Dr. Thomas H. Halsted, Syracuse, N. Y.: A young man came to me with beginning ulcer of the throat. In spite of salvarsan and the iodids he grew steadily worse, and the ulceration extended to the soft palate, then he lost the whole roof of the mouth, nasal bone and external nose. Section removed showed round-celled sarcoma. The man denied ever having syphilis. He died within three months. I think other conditions than syphilis caused a positive Wassermann at times.

Dr. John E. Mackenty, New York: I have seen three cases in the clinic in which there was sarcoma of the neck or throat. There was a positive Wassermann, but the lesion did not clear up with specific treatment. I don't believe a positive Wassermann is to be taken absolutely seriously.

Dr. Lewis A. Coffin, New York City: I cannot but feel that the underlying cause in Dr. Theisen's case was lues; we not unfrequently have cases showing specific lesions and positive Wassermann that fail to respond to the most thorough antispecific treatment, these cases often have at some point a focal infection. If the latter be cleared up by ordinary means the specific symptoms clear up and the blood becomes negative to the Wassermann test.

Dr. Hanau W. Loeb, St. Louis, Mo.: I recall my experience with certain cases of Vincent's angina in the army, in which there was no way of differentiating from syphilis except by the course of the disease.

Dr. W. B. Chamberlin, Cleveland, Ohio: We do get cases of Vincent's angina complicating syphilis. In a recent case we made a diagnosis of Vincent's angina of the left tonsil. Microscopic examination showed spirillae and fusiform bacilli. The case cleared up under salvarsan. Subsequently the characteristic rash of syphilis developed and we found that there had been a primary sore on the tonsil. The condition was masked by the complicating Vincent's. The primary sore had been acquired during what our patient was pleased to call his vocation.

Dr. H. L. Swain, New Haven, Conn.: I think Dr. Theisen's first case should not go without mention. We have all had these cases of multiple stricture of the esophagus and work as hard over those cases as over anything we do. I had one case of complete stricture. The patient disappeared and later was seen after an operation in which someone had tried to reach the stricture through an external opening. The esophagus passed below the cricoid; lower down there was complete stricture behind the arch of the aorta. I dilated with a bougie, and the patient began to take liquid nourishment. I tried to pass a flexible tube into the stomach and the patient immediately complained of pain. The stomach tube had apparently ruptured adhesions between the posterior side of the stricture, and she developed an empyema. Resection of the ribs was done and she nearly died. Finally a complete stricture super-

vened. The patient is a young girl of 17, and I shall do all I can to avoid for her the fate of passing a long life of having to be fed through a gastrostomy opening.

Dr. D. Crosby Greene, Boston, Mass.: I understood in these cases Dr. Theisen say that radium never did any good. I would take exception that statement. In my experience remarkable improvement has occurred in many cases of this type.

Dr. Theisen, closing the discussion: I want to correct an error in the title of my paper. It says "cured," but I would like to change that to "apparently cured." These cases do recur. Dr. Swain's case reminds me of a procedure which you may have tried. I saw a child with complete stricture of the esophagus, after swallowing caustic potash. The child had a gastrostomy done in the hospital, by one of the surgeons, and we finally got a piece of fine whalebone through from above attached to a ligature, and we then sawed through the stricture. It was many months, however, before the gastrostomy wound could be closed. The child swallowed fairly well after a while. As regards syphilis and Vincent's angina, I think often syphilis makes a good foundation for the Vincent's angina to be grafted on. One is subsequent to the other, or they often occur together.

SYMPOSIUM ON RADIUM.

Treatment of Epithelioma of the Larynx by Radium.

By DR. H. H. JANEWAY, New York.

Read by title.

Dosage and Methods of Treatment.

By PROFESSOR WILLIAM DUANE, Harvard University.

In deciding upon the details of an application of radium, or of any of the radioactive substances to a case of malignant disease, one must bear in mind the general principles underlying the methods of radiotherapy. There is no evidence that rays from radioactive substance can transform tumor cells directly into normal cells. The fundamental principle of radio treatment appears to be one of destruction. The rays from the radioactive substance destroy the tumor cells either by passing through them and exerting a direct action on them, or by cutting off their supply of nutrition; just as invading armies are destroyed either by shooting individual soldiers, or by cuttting off their food supply. In order to destroy a tumor by radiation we must fill the tumor and part of the surrounding healthy tissue with rays sufficiently intense to kill the tumor cells, but at the same time we must avoid too great destruction of the normal tissues. The problem becomes largely one of solid geometry. The source, or sources, of radiation must be placed in such positions in or near the lesion as to produce the required effects throughout the volume of the tumor.

The primary effect of the passage of radioactive rays through a substance appears to be the ejection of atoms of electricity called electrons from the atoms of ordinary matter. As a secondary effect a regrouping of the atoms takes place. For instance, if the

rays pass through water, H_2O, they split up the water in molecules, and, as a regrouping of the atoms, we get molecules of hydrogen, H; of oxygen, O_2; of hydrogen peroxid, H_2O_2, etc. Just what regrouping of atoms take place when the rays pass through living tissue we do not know, and, in the nature of the case, are not likely to find out, until we have learned more about the actual distribution of the atoms before the rays passed through them.

Although we do not understand the mechanism of the effects produced by rays on living cells, we do know something about the gross behavior of tumors after radiation. One of the most important effects due to rays appears to be a retardation of the growth of the tumor. This retardation may last for many generation of cells after the generation that has actually received the radiation. The retardation effect is of great value in cases where the situation of a tumor does not allow its complete destruction or removal. The direct action of rays from a radioactive substance on a cell appears to be more pronounced during mitosis than at other times. For this reason prolonged radiation ought to be more effective than short radiation, for there would be more chance of catching a greater number of cells during their most vulnerable period in the former than in the latter case. Over five years ago I used a method of treating certain types of malignant disease with radioactive substances, which has the following advantages: (a) the active sources of the rays may be placed and kept in position with considerable precision, thus ensuring an accurate distribution of the radiation throughout the tumor; (b) very little effect is produced in normal tissue at a short distance from the source of the rays; and (c) the length of the treatment may be prolonged continuously for days, weeks or even months. The method consists in introducing very minute glass tubes containing a very small quantity of radium emanation (often less than one millicurie) into the tumor itself through a trocar. The tubes and emanations are left in place until most, or practically all of the emanation has disappeared. As is well known half of a given quantity of emanation disappears in slightly less than four days, so that in this way the tumor tissue may be subjected to weak radiation lasting a long time.

The emanation in the tubes transforms itself into substances called radium A, B and C, Radium B and C (not the emanation, nor radium A) produce the rays that are used in therapy. The walls of the glass tubes being very thin the radiation passes easily through them, and is absorbed in the tissues immediately surrounding them—most of it within 6 or 7 mm. of the tubes. Hence by accurately placing the tubes in position the radiation can be confined to the required volume of tissue with precision.

Owing to the fact that most of the radiation is absorbed close to the tubes, very little effect is produced at a distance from them. Normal tissue appears to be able to withstand indefinitely the weak rays that reach a distance of 10 or 15 mm. from the tubes. Thus excessive destruction of healthy tissue may be avoided, if the tubes are properly placed.

In certain types of cases, which are particularly well suited to it, the method appears to be the best procedure to follow in applying radioactive substances to malignant disease.

This method has been extensively used in our own hospital and in the Memorial Hospital, New York.

Factors Influencing the Quantitative Effects of Radiation.

By DR. WILLIAM T. BOVIE, Harvard University.

For every treatment in radiotherapy the clinician must decide the following question:

Under a given set of conditions, what exposure must I give to produce the desired effects? The decision is frequently a mere guess, for many more factors are involved in the dosage of radiotherapy than are involved in the dosage of chemotherapy, and chemotherapeutics can scarcely be classed as an exact science.

The students of photography have very successfully solved the dosage problem for the blackening of the photographic plate. Undoubtedly there is much which the clinician may learn from them. With the speed of the plate determined and stamped on the box, formula given for making up developers and fixing solutions, full directions as to temperature control, duration of development, etc., the only thing left to the judgment of the photographer is the intensity of the light to which the plate is exposed, and even here he has been provided witht chemical devices, actinometers, for accurately measuring the power which the light has to bring the silver bromide of the photographic film into the developable condition.

It is not always convenient in clinical problems to measure the intensity of radiations at the place where they are absorbed, but when a point source is used, if the intensity of the radiation is known at any one distance from the source, it is possible by means of Lambert's "inverse square law" to calculate the intensity. This does not apply, however, to other than point sources, nor to sources of the corpuscular radiations A and B rays. By exploring with photographic paper as an actinometer I have measured the intensity of the radiation about small cylindrical sources, such as glass tubes containing radium emanation and have constructed diagrams of surfaces of equal intensity.

It is not sufficient to know only the intensity of the radiation. One of the oldest laws in photochemistry is Grotthus' law which states that "it is only that fraction of the rays which is absorbed that is effective in bringing about a photochemical change." It is necessary, therefore, to know, besides the intensity of the radiation, the fraction of the rays which will be absorbed. Again using photographic paper as an actinometer and beeswax as a typical homogeneous absorbing medium, I have constructed charts and diagrams showing radiation intensities within such an absorbing medium when it encloses a tube of radium emanation as a source for rays.

Photography would not be possible if manufacturers possessed no method of measuring and indicating the sensitiveness of their plates to light. It would undoubtedly help tremendously if we possessed a similar sensitometry for tissues. (Dr. Bovie then discussed the methods of sensitometry of the photographic plate, and showed how these methods may be applied directly to the sensitometry of tissues.)

In order to arrive at a mathematic expression giving the relationship between the exposure and the physiologic effect, it will be necessary to have a term for the intensity of the radiation, a term for the amount of energy required to produce the particular change sought in a single cell or tissue element, a term expressing the absorption index of the tissue to the particular radiation used, a term showing the concentration of the unaffected cells or elements of tissue, and a term expressing the number of cells or elements already altered by the exposure. It may be shown that an expression of this kind leads to the conclusion that the effect produced should vary with the logarithm of the exposure (intensity times the time).

It follows, therefore, that a short exposure is relatively more effective than a long exposure.

One other term must be introduced into such a mathematical expression, namely, a term which the photographer calls "the factor of development." The initial photochemical change latent image, produced by the exposure cannot be detected. It is only after a period of development, in therapy a period of physiologic change, that the effects of the radiation are manifest. Unfortunately at the present time we are quite ignorant of the nature of, and the laws which govern, the rate of these physiologic changes. It is for this reason that many of the results of radiation treatment are charged to the idiosyncrasies of the patient.

It is a step in advance to formulate a problem even if we are unable to solve it.

The Results of Treatment of Malignant Disease of the Upper Air Tract by Radiation.

(From the Clinic of the Huntington Memorial Hospital, Boston.)

By D. CROSBY GREENE, M. D.

In treating carcinoma of the larynx with radium, we are confronted at the outset with the problem of making accurate applications of the desired dosage to the exact location required. Owing to the intolerance of the larynx to foreign bodies and the involuntary movements of gagging, swallowing, and coughing, even after thorough cocainization, such accurate application is not practicable by any method of surface application from within. I believe that some improved method of insertion will prove to be effective in a fair proportion of cases which are not far advanced.

This method is especially applicable to the cases of extrinsic cancer involving the tissues about the orifice of the larynx in which complete surgical removal would involve excision of the tongue, total extirpation of the larynx, and resection of the upper esophagus.

In cases of intrinsic carcinoma, operation by window resection of the thyroid cartilage, leaving the wound open for immediate and subsequent radiation, is an effective method of treatment in some cases.

The effectiveness of any method of radiation from a clinical standpoint, depends on the extent of destruction of tumor tissue. While the tumor cells have been shown to be less resistant to the action of the rays than normal tissue, in order to furnish suffi-

cient strength of dosage to reach those tumor cells which have invaded normal tissue beyond the limit of gross inspection, some normal tissue also must be destroyed in the process. Unfortunately, cartilage which forms the framework of the larynx although peculiarly resistant to invasion by cancer, is especially vulnerable to the rays. Therefore, as a result of radiation, perichondritis and necrosis of the cartilage is likely to take place, resulting later in permanent stenosis of the laryngeal passage.

In early intrinsic cancer, surgical treatment by thyrotomy without radiation, up to the present time has yielded such brilliant results that it is still the method of choice.

The speaker presents the following conclusions:

1. In malignant disease of the regions we have considered, the chief value of radium lies in supplementing rather than supplanting operation.

2. In cases of extensive extrinsic laryngeal carcinoma about the upper orifice, in which operative removal entails excessive operative risk, benefit may be expected in a small proportion of cases by radium treatment alone. In our hands the method of insertion of seeds under direct inspection has been the most effective in such cases.

3. In early intrinsic carcinoma of the larynx, the operation of thyrotomy and excision without radiation is still the method of choice. This conclusion is based on the untoward secondary results which have followed in certain cases caused by the destructive effects of active radiation on the cartilaginous framework of the larynx. The results from thyrotomy in early cases are too favorable to lead one to employ radium treatment under these circumstances. In moderately advanced cases, however, the use of radium to supplement operation is advisable.

4. In most cases palliative results in the way of retardation of the growth and relief of pain may be expected by radium treatment in some form.

5. In advanced upper jaw cases treatment by operation followed by radiation has given promising results.

DISCUSSION.

Dr. D. Bryson Delavan: From personal experience as well as that of many others practically interested in the subject with whom I have conversed, and from what may be deduced from the statements of various authorities whose views upon the subject have been published, it would seem that the present situation with regard to the value of radium in malignant disease of the upper air passages may be thus summarized:

1. The histological character of a growth to which radium may be applied will have an important influence upon its effect.

2. In certain types of malignant growth under favorable conditions, the use of radium may effect a cure.

3. In cases where the prospect of a cure is not probable, under the use of radium there has often been observed a distinct temporary retrogression of the growth.

4. Even in otherwise hopeless cases radium is likely to relieve distressing symptoms of pain, discharge and their attendant sequels.

Dr. J. Payson Clark, Boston, Mass., showed a man, 33 years old, who has had a large tumor involving the right tonsil and adjacent structures, clinically diagnosed as sarcoma. Later a small piece, snipped off for examination, was pronounced by the microscopist "malignant lymphoma."

The tumor was treated by imbedding small glass tubes of radium emanation into it. The tumor was compleetly destroyed after four months' treatment, and there has been no recurrence a year and a half from the completion of the treatment.

Dr. F. E. Hopkins, Springfield, Mass., presented the history of a boy of 17, native, extraordinarily tall and slender, who stated that during the previous summer he had an acute infection of his throat, "a severe tonsillitis," with high temperature and marked prostration. A prominent symptom was difficulty in swallowing, which became serious because of interference with nutrition. He was taken to a hospital and fed by tube, and bougies were passed to dilate the supposed stricture of the esophagus. This was continued for six weeks, the patient meanwhile becoming very weak and unable to sit up. X-ray plate showed an obstruction near the cricoid cartilage, displacing and closing the esophagus from the posterior and right side. The question of an abscess was considered, palpation showed a yielding mass but not a fluid content. It was then suggested that this growth was an accessory thyroid and the patient treated by radium and X-ray. The technic of the treatment is fully given, with illustrations of the fluoroscopic picture. There was a steady improvement following this treatment, the patient gained 30 pounds in weight and can now partake of food in a perfectly normal manner.

DISCUSSION ON SYMPOSIUM.

Dr. C. G. Coakley, New York: It has been proven experimentally and clinically that while there is a partial destruction of the tissues of the pharynx and larynx and improvement of the patient, there is apt to occur suddenly a rapid extension and increase of the growth, such as occurs in no other way. One point observed in radium treatment of the nose and nasopharynx is the extraordinary amount of pain and burning produced which no medication will allay.

I have had eleven cases of cancer of the larynx treated by radium. In one of them the growth was limited to one-half of the cord. The man was given an improperly screened dosage, and while the growth diminished there was terrible destruction of tissue, including the trachea.

There was not a trace of epithelioma found at autopsy. There was a septic bronchopneumonia due to absorption of toxic material. In another case there was an epithelioma involving the upper part of the larynx. Tracheotomy had been performed two weeks previously. Considerable granulation tissue about the tube was radiumized, leaving a healed surface.

Five cases of fibroma of the nasopharynx did remarkably well. One of epithelioma of the palate had a recurrence after eight months. One case of constant asthma caused by nasal polyps was treated by radium with relief of the asthma and disappearance of the polyps.

Dr. H. P. Mosher, Boston, Mass.: I have had more experience with cancer of the upper jaw than with cancer of the larynx. Radium has proved to be of most use in superficial growths, and in growths like those of the upper jaw that have been made superficial by operation. In jaw cases I am strongly against opening into the mouth if it can be avoided.

Dr. Harry A. Barnes, Boston, Mass.: My results with radium alone have been uniformly discouraging. I have, however, found it an invaluable adjunct to operative measures, used, immediately after removal of the growth, on the whole operative field. In eight cases of malignant disease of the accessory sinuses, a radium tube of 35 to 40 milicuries was placed in the center of the postoperative pack and allowed to remain there throughout convalescence. Subsequent radium treatments were given through an opening in the cheek made by cutting away a triangular flap from the facial integument at the end of the operation. These radium exposures were given, not because of any recurrence, but with the idea of destroying microscopic particles of tumor impossible of removal by operation, and also to counteract the possible tendency of metastatic formation which the crushing nature of the operation might have produced. Of six cases of carcinoma, three are dead; two are alive and with no signs of recurrence after 26 and 17 months, respectively. Two cases of sarcoma are alive and without recurrence after 28 and 18 months, respectively. There was one death directly attributable to operation. Of the eighth cases, four (50 per cent) are alive and without recurrence after intervals of from 17 to 28 months.

Dr. Harmon Smith, New York: I regret exceedingly the absence of Dr. Janeway, as he had embodied in his paper the histories of a number of my cases, and their absence lessens materially the force of my remarks.

My earliest cases were far advanced, and it became often necessary to perform a tracheotomy before they could be turned over to Dr. Janeway, and all these went on to their doom in about a year and one-half.

Following this in a case of lymphosarcoma of the tonsils of a boy of 18, I had removed the right tonsil; then in about 18 months a similar involvement of the left occurred and was removed, and then radium was applied. He remained free for about two years, and there never was any recurrence in the pharynx, but there was metastasis in the chest and head, and he ultimately died.

The next case was one of lymphosarcoma of the tonsil. There was no operation; radium was applied, and though observed for two years there was no evidence of return.

The next two cases were typical nasofibroma. The first in a boy of 16. In spite of repeated removal, and the injection of monochloracetic acid the recurrence was fearfully rapid. Radium treatment at several intervals had no effect and he died of hemorrhage.

The second case was of the same character as the first. The patient disappeared and did not return for about a year. There then was a marked improvement in his condition, and monochloracetic acid was again injected and after a few months the growth had almost entirely disappeared.

The next in the series are those of cancer in the larynx.

It occurs so frequently that patients come to us with the direct request for radium to be applied, and the question of operation is a secondary matter, that I feel the need for calling attention to the fact that the cure of cancer by radium has been unjustifiably advertised to the laity. In many cases we may lose the crucial importance that we promptly determine exactly what radium can moment by applying radium first. It is certainly of the greatest do and likewise ascertain its limitations.

Dr. J. E. Mackenty, New York, presented a larynx, which shows the effect of radium treatment. Radium gas was injected into the larynx direct and left in. Three weeks later there was an enormous edema of the larynx, tracheotomy and nasal feeding became necessary. Septic bronchitis followed and operation was done under local and general anesthesia. The larynx was the site of a large abscess cavity. The patient made a rapid recovery.

Acute Abscess of the Lateral Wall of the Lower Pharynx.

By DR. CHARLES W. RICHARDSON, Washington.

The speaker described an unusual type of abscess of the laryngopharynx. The origin of it was uncertain. Symptomalogic characterized by the sudden onset and the severity of the pain; tumefaction not manifest until the second or third day. Pointing takes place deep down in the lateral wall of the lower pharynx. There is little alteration of voice or interference with breathing; deglutition very painful, but not impossible. Septic temperature of moderate type. Treatment: Early evacuation.

DISCUSSION.

Dr. Henry L. Swain, New Haven, Conn.: In 1913 I published in the Transactions of this association a report of five or six cases of a similar nature, which I called abscesses of the lateral column of the pharynx. There was marked edema of the larynx. A recent case of mine had no edema and was exactly like the one described by Dr. Richardson.

Dr. J. E. Mackenty, New York City: I had several cases of this affection last winter. In one there was danger from edema of the larynx and the neck was opened. I believe external operation is far safer, as probing for pus in the edematous tissues of the throat is a very dangerous procedure.

Dr. Richardson, closing the discussion: Dr. Swain's cases are not quite like the cases reported. His cases were those of descending infection of the lateral wall and the posterior pillar.

Nasociliary Neuralgia.

By GREENFIELD SLUDER, M. D., St. Louis.

Pain in the eyes, brow, and root of the nose is frequent and may be of different origins. Localization of the pain of the several origins by the patient is not precise. Pains of frontal, ethmoid and sphenoid sinuses, or nasal (sphenopalatine-Meckel's) ganglion, or supraorbital or nasociliary nerve origin may overlap in their sensa-

tions. This last pain is usually referred to the small district bounded by the supraciliary ridge above the supraorbital notch laterally and the nasal bones below. Sometimes it extends to the tip of the nose. Rarely it is referred to the eyes. Patients often complain that they cannot wear their glasses because of soreness of the nasal bones. Severe degrees, however, of whatever origin, may be referred beyond these limits. Pain of supraorbital neuralgia is more widespread. Pain of suppuration of the frontal or ethmoid sinuses under pressure is of long known recognition.

(Here follows careful anatomic description of the nasal nerve and its branches.—E. M.).

It is to be seen that the nasociliary nerve, as it enters the nose in its uppermost anterior limit, is quite near the surface of the membrane. It is more superficial than the nasal ganglion (usually). The ganglion may, however, be quite superficial (submucous). So it is easily understandable that an inflammation of the membrane in this part may irritate or inflame the nerve and produce pain. In older cases with general hyperplasia of membrane and bone, it is also easily understandable that the ethmoidal slit may be encroached upon to narrow its caliber and place the nerve in a more easily vulnerable position.

DIFFERENTIAL DIAGNOSIS.

The nasociliary nerve is more easily cocainized than the nasal ganglion. A small applicator with 20 per cent sol. suffices. It is passed upward on the inside of the nose, being held forward in contact with the anterior limit of the nasal fossa until it reaches the roof of the fossa. By this procedure it arrives automatically in the apex of the angle formed by the cribriform plate above and the anterior limit of the nasal fossa. It is at this point that the nasociliary nerve enters the nasal fossa. When the pain in this region is of nasociliary origin, such an application of cocain will stop it in a few minutes. Should it be of the other origins mentioned above, it will not be influenced by such an application.

My observation so far has been that nasociliary neuralgia has usually been a transitory phenomenon in the course of cases which have been in observation or treatment for something else. The nasociliary neuralgia would appear from time to time in the course of other clinical conditions, and was usually not obstinate. It would yield to cocainization and applications of dilute carbolic acid, ½ per cent. Four times, however, I have seen it the only clinical phenomenon. Once I injected the nerve trunk at its entrance into the nose, with relief to the patient. The technic is that first advocated by Otto J. Stein in his alcohol injection treatment of hyperesthetic rhinitis.

A straight needle is passed upward in the nose in the same way as the applicator for cocainization described above. A few drops of 95 per cent alcohol with 5 per cent phenol are instilled into the nerve trunk at its exit from the ethmoid slit.

DISCUSSION.

Dr. Henry L. Swain, New Haven, Conn.: Dr. Sluder gave us the sphenopalatine ganglion syndrome, and now he is teaching us the

nasociliary type to be added to the neuralgias which have borne his name all over the world. I have had an interesting case of this affection, of which Dr. Sluder writes me that it is an exquisite case. The Ewing's sign was very marked. That was relieved by the application of cocain to the sphenopalatine ganglion. In this case the pain in the angle of the orbit was the troublesome feature, and treatment to the eye was of no avail, while a single application to the ganglion achieved the effect immediately.

In my hands a weak solution of nitrate of silver prolonged the beneficial effect of the cocain. I hesitate to apply carbolic and alcohol for fear of severe reaction, which occurred in this patient and lasted 24 hours, from the simple application of nitrate of silver.

Dr. Harmon Smith, New York: The excellence of Dr. Sluder's articles has been manifest to me in my official capacity, in that the copies of the Transactions of this Association containing his reports have been in unusual demand.

In one case of mine the patient, a lady from California, who had several operations upon her left maxillary sinus. These were followed by intense pain on that side.

I was to try the Sluder method, but expecting him in New York shortly, I awaited his arrival and submitted the case to him.

Local anesthetization had no effect, and Sluder was averse to have the patient return with him for further treatment. I should like to have Dr. Sluder state his reasons for that decision.

Dr. Faulkner injected the ganglion with alcohol with only temporary effect. Radium within the antrum produced excruciating pain. Dr. Sharp removed the semilunar ganglion with immediate relief.

Dr. J. E. Mackenty, New York: A patient of mine had a nasociliary neuralgia, with considerable inflammatory tissue. This was removed with the Sluder knives, with cure of her pain. In another type of case there is a sense of pressure over the distribution of the nasal nerve, a pressure from within which causes great distress and does not yield to treatment. I would like to know if Dr. Sluder would include this in the nasociliary cases?

Dr. H. W. Loeb, St. Louis: The interesting part of this report is that it makes it possible to differentiate this type of pain from other types of nasal origin. Has Dr. Sluder met any cases with pain referred to this region but with a distinct point of origin?

Dr. Norval H. Pierce, Chicago, mentioned the case of a minister who was compelled to give up his work in church on account of a phonetic spasm associated with grotesque facial contortions.

As he complained of pressure symptoms in the nose, equal parts of cocain and sugar of milk were blown up the nose, with the surprising result of the disappearance of the spasm and the return of a normal voice. After that, whenever he had to preach or talk he used a tablet of 50 per cent cocain and sugar of milk. This occurred before Dr. Sluder published his work. It is possible that the case may have been one of reflex trouble from the nose. It was remarkable that cocain relieved the pain, whether applied to right or left side of the nose, also that hypodermic injections had the same effect. Hence in these conditions I feel that we cannot eliminate the systemic effects of cocain.

Dr. James E. Logan, Kansas City: Dr. Sajous used cocain on the turbinates in his study of the reflex neuroses of the nasal cavity, but Dr. Sluder has brought out more clearly the relations of the subject from the diagnostic and remedial standpoint.

Dr. Sluder, closing the discussion: Dr. Swain's case was evidently a nasal ganglion neurosis and I suggested that he inject it. I presume, also, that she was very neurotic and difficult. In such cases the injection should be carried out under nitrous oxid anesthesia and a small amount of cocain applied to the nasal ganglion. The gas does not complicate the issue. By adding methylene blue to the alcohol it can be seen if it enters the throat. Nitrous oxid is preferable to ether, and a straight needle better than a curved one.

Dr. Harmon Smith: The case I mentioned had been operated on for maxillary sinusitis, and continued to suffer from neuralgia. Cocain did no good. Dr. Sluder advised against continuing.

Dr. Sluder: Such cases are extremely difficult. The nerve supply of the nasal ganglion may come through the sphenoid fossa. In Dr. Smith's case a Gasserian ganglionectomy was done, I presume. If the entire sensory supply is removed a cure follows in some cases but not in all. The question is what is the source of pain. My opinion is that the pain is transmitted by the sympathetic fibers that run through the nose. It is claimed by some that the sympathetic is purely a motor system and that there are no fibers of a sensory nature at all. While, on the other hand, there is sufficient at hand to show that there exists a motor and sensory supply taking in the spinal ganglion. Cushing thinks that all this work is a mistake, and I hope to argue it with him shortly, before the American Laryngological, Rhinological and Otological Society.

Dr. Pierce's case is very interesting and raises the question as to how much of this effect is due to absorption and systemic influence. This effect has been so carefully watched since 1903 and the prompt response of relief when the proper spot was touched, and only then would indicate the localization of the diseased condition and its prompt relief.

I have seen similar cases to that of Dr. Pierce, complicated with blepharospasm. Cocainization of the nasal ganglion relieved the orbicularis spasm and soft palate for 12 hours. I shall try, however, the subcutaneous injection of cocain in my next case. I have injected in the edema of hay fever when the whole nose was occluded and this was cleared up by injection.

Esophagismus and Allied Disorders.

By DR. THOMAS HUBBARD, Toledo.

Complete reversal of peristalsis culminates in emesis, but the interesting fact is that the important clinical manifestations are partial or abortive reversals. Globus, heartburn, erophagia and belching, regurgitation and nausea are familiar clinical examples.

We are inclined to attribute socalled biliousness and bad taste in mouth and foul breath exclusively to throat, nose and mouth conditions, and certain it is that we have met disappointments in attempts to give relief by ordinary treatment.

Recent clinical and experimental observations are convincing that reverse peristalsis can be a factor in causing any of these symptoms.

Pyloric and cardiac control are influenced by the chemical reactions, and likewise the cricoid may react against the acid of reversed peristalsis. This may produce the symptoms which we call globus.

Attention has been called to the blending of involuntary and voluntary nervous energy in this region and with true globus hystericus in mind we can appreciate what is meant by psychic interference. It is characteristic of the psychic factor that the function as a whole rather than certain nerve tracts give evidence of interference. The hypoglossal, glossopharyngeal, pneumogastric and spinal accessory, and even the phrenic, controlling salivary and mucous membrane secretions and the muscular action direct and auxiliary of food ingestion may any or all be affected.

With consciousness of dysphagia, the psychic factor of alarm may cause a reaction of hyperesthesia in areas previously anesthetic, and the tonic spasm results—a spasmogenic phenomenon. The foreign body sensation is very common in this type of throat trouble, and reversely, throat hysteria can be induced by a real foreign body.

The terminal of the tube at the hiatal orifice, commonly called the cardia, is subject to spasmodic constriction enduring even to the degree of threatening life. (Jackson objects to the term "cardiospasm," preferring hiatal spasm, and he is correct, as usual.) It is primarily a phenomenon of partial reversal. Chronicity, in this instance, naturally follows distortion due to sacculation above the stricture, and even in fatal cases—death from starvation—there is found little or no hypertrophy of circular muscle fibers at cardia or hiatal regions.

The following conclusions are presented:

1. The pharyngeal plexus is concerned with a primitive function of such vital importance that even slight disturbance may provoke psychic interference with resulting confusion of automatic reflexes.
2. Chronic spasmogenic phenomena, esophagismus and cardiospasm, may be primarily manifestations of irregular or reversed peristalsis.
3. The hysterical throat is a manifestation of paresthesia and incoordinated muscle actions with psychic fixation in neuropathic individuals.
4. It is probable that disease conditions and local irritations of the gastrointestinal tract may initiate the reverse peristalsis involving the esophagus. Abnormal reflexes and sensations are naturally referred to the beginning of the vegetative tract—the region of the pharyngeal plexus.
5. Through intimate anatomic association, the throat and larynx participate in the clinical syndrome. The gastric factor in asthma may be thus explained.
6. The more we emphasize peristalsis as a factor in digestion, the more important is it to properly interpret abnormal peristalsis as a factor in disease.

Dr. R. B. Shurley, Detroit, Mich.: We see a number of these cases in this rapid, nervous age. They can be watched through the fluoroscope and the spasm seen. Dilatation causes great relief, as also full doses of the bromides. These cases represent instability of the nervous system of the vasomotor type. Reestablishment of the nerve tone by hypodermic injections of iron and glycerophosphates and dilatation of the esophagus are beneficial. I had one patient who was unable to eat when anyone was looking, and another who could only eat while standing. Patients of this type would eat sandwiches and other foods in the office which they declared they could not eat at home.

Dr. Lewis A. Coffin, New York City: I have long laid stress on the importance of the care of the gastrointestinal tract in affections of the upper air passages. This holds specially where there isa disturbance of the vasomotor system. Rhinorrhea, sneezing, hay fever and asthma are not infrequently caused by gastrointestinal disorders, and are frequently relieved by appropriate treatment to the cause.

Dr. H. L. Swain, New Haven, Conn.: In the exhibit by Dr. Mosher, I noted that the lobe of the liver was very near the lower pole of the esophagus. Supposing this lower lobe impinged on the esophagus, a marked effect might be produced, both mechanical and obstructive, as well as inducing spasm.

Dr. Henry L. Lynah, New York City: A great many cases of malignant disease of the esophagus occur and are labeled hysteria, and they are only discovered after death. The functional spasms become organic sooner or later.

Dr. Hubbard, closing the discussion: There is no disease more difficult to cure than cardiospasm. Many cases of this affection are diagnosed as organic stricture, and the autopsy shows no lesion. Just what makes the formation of the sacculation is not determined. Dr. Coffin wrongly labels his cases granular pharyngitis. All pharyngitis is caused by chemical irritation and autointoxication, perhaps due to retarded peristalsis. Chemical digestion takes place in the gastrointestinal tract, and disturbances of rhythm upset the whole process. Organic disease is the cause of spasm. I have one case of a man who could only swallow liquids, who has a small, pendulous, nonmalignant tumor just below the cricoid which I expect to snare off. The importance of reverse peristalsis as a cause of obscure throat lesions has long been apparent to me.

Intrinsic Carcinoma of the Larynx, with a Second Report of the Cases Operated on by Suspension and Dissection.

By DR. R. C. LYNCH, New Orleans.

Every case has been carefully studied with a negative Wassermann and a negative clinical test against syphilis and tuberculosis, and the tumor mass removed in each instance has been carefully submitted to a pathologist of repute with the simple notation that the tissue is from the larynx.

Under suspension it is perfectly possible to palpate with a feeler with quite as much certainty as one does with his fingers upon the

surface of the body, and because of the peculiar location of the lesion and the anatomic construction of the cartilaginous box in which this growth takes its origin, it seems very easy, for me at least, to make out quite definitely the area of involvement, and thereby making due allowance for microscopic invasion, to cut sufficiently wide the growth to insure its removal, at least with as much assurance of success as one operates for this dread disease in any other part of the body, including thyrotomy and the total extirpation of the larynx.

These are a few points to be remembered:

First, after having determined that the case is suitable for intrinsic dissection, it is necessary to have the consent of the patient to do all or anything that is necessary, for while under suspension you may determine that thyrotomy or even laryngectomy is the only possible chance to save the individual from this disease and preserve his natural breathway. If you have done a few thyrotomies for intrinsic cancers diagnosed by mirror only, then I feel sure that you have been surprised at the extent of involvement—usually far beyond your expectation.

Second, that since it is determined that the case is suitable for intrinsic dissection, when once the forceps take hold of the mass they should not let go to avoid the possibility of cell implantation from this source.

Third, that the tumor circumscribed, as is possible from an anatomic standpoint, and is usually delivered upon a cartilaginous plate, not having permitted the cutting instruments to come in contact with the tumor mass again to avoid implantation.

Fourth, there must be no special desire to save tissue for subsequent functional use, for fear that in your desire to save tissue the removal will not be complete.

Fifth, all raw surfaces should be sealed with the actual cautery at a cherry red heat that this may seal the lymphatic drainage outlet from the raw surface and with the hope that the heat thus applied will kill any remaining cancer cells that may have been displaced during the operation.

The advantages of the operation are that, being especially suitable for the very early cases where there is apparently very little involvement of tissue, it can be done quickly and without external incision; that the normal breathway is not interfered with, since trachectomy is at no time necessary, and the chances of postoperative contraction are most remote; that the operation is carried on entirely within the closed box, which should offer the very best opportunity against metastasis, spread or involvement without the box; that convalescence is unusually short and the surface can easily be watched by mirror, and finally, when convalescence has been completed there is more likelihood of nature establishing a cord with which the voice function can be reestablished.

The histories of nine cases are presented. One is dead of recurrence. Two others had a recurrence; they were subjected to a laryngectomy and are still well and healthy and useful citizens. The other six are perfectly well. One, six years after the operation; one, four years after operation; one, three years after oper-

ation; two, two years after operation, and, at this time, one, six months after operation.

DISCUSSION.

Dr. D. C. Greene, Boston, Mass.: I have no objection to any method of removing cancer provided the entire mass with a sufficient margin of healthy tissue is removed intact. I believe that Dr. Lynch's method is successful in his hands on account of his extraordinary skill, and I do not believe it can take the place of thyrotomy in general. I have, however, found the Lynch apparatus most useful as an adjunct in the thyrotomy operation.

Dr. J. E. Mackenty, New York City: Dr. Lynch's results, nine cases and eight recoveries, are far better than the external method of operation, and probably he sees them in the early stages. Seventy-five per cent of the cases I saw last year were inoperable. I did three thyrotomies, otherwise a total laryngectomy. We have but one choice, recurrence spells death. One objection is leaving the cartilaginous wall of the larynx. It leaves an indurated mass which will granulate and give trouble. Removal of the laryngeal wall with the cancer mass is of advantage in the technic of this operation.

Dr. Lynch: I removed the perichondrium but not the cartilage.

Dr. Mackenty (continuing): I believe that it is disadvantageous to leave the cartilage there with such a poor blood supply. It is difficult to judge of the extension of a cancer of the larynx looking down upon it while under suspension. I am averse to removing tissue for examination, as it disseminates morbid cells.

Dr. Norval H. Pierce, Chicago, Ill.: In operating for the removal of early malignant neoplasms of the larynx he preferred laryngofissure to suspension. While no one can question the superior operative dexterity of Dr. Lynch, still he regards laryngofissure as the preferable procedure in these cases because it gives a better view of the operative field, the removal can be accomplished with greater accuracy and the dangers are no greater. He can report a little over 50 per cent of recoveries which have remained well over a year in cases where early malignant neoplasms have been removed by laryngofissure. His greatest mortality has occurred in cases which have been left open for the purpose of applying radium.

Dr. Shurley asked if radium was used in these cases? Dr. Logan asked if any galvanocautery was used. Dr. Hubbard asked to have the technic of combined suspension and laryngectomy explained.

Dr. Lynch, closing the discussion: This report is preliminary and may be extended later on. None of the cases had radium, either before or after operation. In one case I had to do laryngectomy where radium had been used, and there was so much slough that the case ended fatally. All open surfaces were touched with the galvanocautery after operation, in the hope of destroying any scattered cells. Students watching the operation are apt to be impressed with the fact that these cases can be dealt with early. I have been seeing more early cases than formerly. The suspension is ideal for extirpation of the larynx and trachea. I always refrain from removing tissue for diagnosis, except at time of operation.

Lung Mapping by the Injection of Bismuth Mixtures in the Living. Preliminary Report.

By DR. HENRY LOWNDES LYNAH, New York.

The following summary is presented:

1. That bismuth substances can be injected into the bronchi and lung of a living patient without doing damage.

2 That the injection of an opaque substance into the lung of the living patient will open up an enormous field of usefulness in the study of cough the expulsion of substances from the lung and lung drainage. It will also localize bronchial strictures in the same manner as seen in the esophagus. Furthermore it will be of the greatest aid to the thoracic surgeon by mapping out the abscess cavity in the respective lobe of the lung.

3. A definite lung abscess cavity is seldom seen bronchoscopically and pus is usually seen coming from a branch bronchus. The abscess cavity may be well around the corner and not in that portion of the lung from which the pus is oozing. An injection of bismuth mixture or some other opaque mixture will close up this error.

4. Bismuth, when it enters the abscess cavity, is interpreted by its metallic luster and when it is in the lobular lung structure it is interpreted as a dull opaque spot. Pus diffuses and soaks the lobular structure, and this often makes the area involved appear many times larger than it really is.

5. The amount of bismuth injected in these patients was an 8 cc. mixture of bismuth subcarbonate on part, in pure olive oil, two to three parts. The mixture is rendered sterile before injection by boiling.

6. The injection should be made slowly and not with a squirt, for the picture may be spoiled by bismuth lung soaking.

7. There seems to be from these preliminary studies that cough and the action of cilia are not the only means of expelling secretions from the lungs.

8. While bismuth mixtures were originally injected by the author for the purposes of lung mapping of abscess cavities in their respective lobes it seems to have been of apparent benefit to the two patients upon whom it was tried. So far it has done no harm.

DISCUSSION.

Dr. Thomas Hubbard, Toledo, Ohio: I think Dr. Lynah's technic is marvelous and the possibilities immense. Besides the diagnostic there is the therapeutic aid of the healing properties of bismuth. I had one experience of the accidental aspiration of bismuth.

Dr. Mackenty asked how much importance the speaker attributes to cleaning out the cavity and how much to bismuth.

Other speakers asked the strength of bismuth in the mixture and how much was injected.

Dr. Norval H. Pierce, Chicago: In connection with the subject of inspection of bismuth for the purpose of outlining cavities, Dr. Pierce desired to bring to the attention of the society certain work

that is being done by Dr. Cavanaugh of Chicago in this direction for the purpose of ascertaining the position and extent of the sphenoid sinus. The removal of this mass after the picture has been taken may be attended with some difficulty; also, in consequence of the density of the bismuth mass usually employed it may not reach all parts of the cavity. In order to overcome these two objections Dr. Pierce suggests that it might be found feasible to make a sprayable mixture of bismuth or barium in an albumin fixing menstruum, and this, by means of a suitable spray, might be sprayed into the cavity Or the albumin fixing mixture might precede the bismuth.

Dr. Lynah, closing the discussion: I used 8 cc., the cases had improved before bismuth was injected. The bismuth was only injected for diagnostic purposes.

Some Indications for Operation on the Nasal Sinuses in Children.

By DR. L. W. DEAN, Iowa City, Iowa.

Three cases of arthritis vastly improved as a result of sinus operation are fully recorded.

With rather a large number of cases of multiple arthritis referred to the laryngologic clinic, it has only been necessary to treat or operate the sinuses in a very few cases. When we have found nasal sinus disease present in this condition and the etiological factor is the hemolytic streptococcus we have found great difficulty in eradicating the nasal sinus disease as compared with non-complicated, sinus disease in children.

We feel that all cases of systemic infection in children that are ordinarily due to foci about the upper respiratory tract, if not checked by the removal of diseased tonsils and adenoids, should come in the hospital for study of the nasal sinuses. We have only been able to study them satisfactorily by having the patients in the wards where they are under constant supervision. If the nasal sinus disease is present we find it necessary to hospitalize these patients for six to nine months in order to get satisfactory results. This gives the best opportunity for that careful study which must precede all operative work in the sinuses.

With the cases just cited we feel that the focus of infection was in the nasal sinuses and that it could only be removed by operation on these sinuses. The removal of middle turbinate and the destruction of sinuses have been justified by the results. In these three cases if the foci had not been obliterated the result would probably have been an ankylosis of all joints utter helplessness, and a slow, painful death.

As the result of the work our patients, although cripples are well nourished, happy, free from pain, enjoy play and, with proper education, will be self-supporting. These children are our best friends, their gratitude compensates us many times over for the time and work necessary for the proper handling of their cases.

Dr. Ross Hall Skillern, Philadelphia, Pa.: We do not see these cases in Philadelphia, and there are three reasons for this: 1, we may not have them; 2, I doubt if we would recognize them, and 3, the parents would not allow us to keep the children long

enough in the hospital to study them carefully. The diagnosis of these cases require long and careful study.

Dr. Harmon Smith New York: During the past winter I had an unusual number of children with sinus involvement. Most of them had bronchitis which had failed to yield to treatment. After shrinking the puffy mucosa with solution of adrenalin, 1-1600 of rosewater, I either douched their nares with a hot alkaline solution with a Douglas douche, or the postnasal douche as first suggested by Chappell. I then employed a 1 per cent argyrol solution in my sinus suction syringe, which not only sucked out the remaining pus but also introduced the argyrol solution. The majority of these cases recovered completely within from two to three weeks, both from the sinus affection and the bronchitis.

For a number of years we have employed filtered sea water, to which 1 minim of carbolic acid to the ounce has been added, for irrigating purposes. This is much more valuable than normal saline.

Dr. B. Alex. Randall, Philadelphia, Pa.: In 35 years' duty at the Children's Hospital we saw many cases of diseased sinus. In extreme cases we passed alligator forceps into the sphenoid and withdrawing them open divulsed the front wall and thus opened drainage.

Dr. Charles W. Richardson, Washington, D. C., reported a case of extreme exophthalmos, primarily an acute mastoid infection, right side, acute suppurative otitis left side, when first seen. Incision of the left ear; subsidence of ear symptoms; exophthalmos left eye gradually increased, blood, bacteriologic and other examinations seemed to show it to be a case of orbital leukemia.

Dr. Henry L. Swain, New Haven, Conn.: I had one case in which the infection of the orbit was caused by a single tooth extracted from the lower jaw. The infection passed up the ramus of the jaw out by the pterygoid fossa and pterygomaxillary fossa and into the orbit. No pus occurred in the orbit, but exophthalmos was sufficient to cause permanent blindness.

Dr. H. P. Mosher, Boston, Mass., asked at what age it was feasible to wash out the antrum of a child and how early the sphenoidal sinus was an operable cavity?

Dr. J. H. Bryan, Washington, D. C.: These are desperate operations but, nevertheless, are justified. Many think that because a child is young radical measures are cantraindicated.

Dr. J. E. Logan, Kansas City, Mo., asked if Dr. Dean used autogenous vaccine before or after operating. This has proved a potent factor in clearing up the cases before operation. He has used it as a regular procedure.

Dr. G. Sluder, St. Louis, Mo.: No matter how much bone you take out of a child's nose the activity of the bone cells is such that in three months' time the bone will be replaced. You take desperate chances in bone removal in children. Do not operate on the paranasal sinus in children except in conditions of dire distress. We may consider the sphenoid as a sinus to be dealt with at the age of five.

Dr. J. E. Mackenty, New York City: As regards the bacteriology in these cases the S. hemolyticus is one of the most difficult to deal with and eradicate. In the long chronic cases the S. aureus is

the most common germ. The sphenoid sinus is the most devilish to treat. The question to settle is how much we are justified in operating on the sinus in children?

Dr. Dean, closing the discussion: I have performed extensive operations on the nasal sinuses in children only a very few times. The youngest operative sphenoid was 5 years and 4 months. A prolonged study of the case is most essential in diagnosing nasal sinus disease in infants and young children. Every possible method of examination must be used. The nasopharynogscope is of particular value. Microscopic examination as well as cultures of the contents of the sinuses give a most definite result. X-ray picture is always necessary. To secure the contents of the Highmorian antrum for microscopic examination and culturing the following procedure is used: With an X-ray plate before us a trocar is introduced into the sinus through the inferior meatus. Even if the floor of the Highmorian antrum does not extend below the inferior turbinate if the X-ray plate is carefully watched, the sinus may be readily entered without danger of complications. Through this trocar a very slender sterile needle is inserted into the sinus and its contents aspirated. Within the last few days in a boy 2 years old suffering from trophoneurosis of obscure origin such an examination gave from one Highmorian antrum thick, yellowish-white pus. The culturing of the sphenoid is not so exact as the Highmorian antrum. In this instance, after cleansing the upper nasal chambers with 50 per cent alcohol a slender German silver canula is inserted into the sphenoidal sinus and its contents aspirated. Naturally, the needle becomes contaminated with its passage through the nose and it is always questionable as to whether organisms cultured are from the sinus or from the nose. When, however, the material thus secured is found to contain pus cells or pyogenic organisms we feel certain that sphenoid sinus disease is present. In cases where we have painted the neighborhood of the ostium of the sphenoid with a solution of methylene blue, the methylene blue has not appeared in the material aspirated from the sphenoid.

I was very much interested in Dr. Richardson's report of his case. I believe it to be a case of chloroma. I feel certain that his case will come to autopsy and the characteristic greenish tumor will be found.

A New or Hitherto Undescribed Form of Maxillary Sinusitis.

By DR. ROSS HALL SKILLERN, Philadelphia, Pa.

The history of the case of a female aged 50, single, is presented. A severe cold began some six months previous, remaining in a more or less chronic form with occasional acute exacerbations. Soon thereafter a postnasal discharge containing blood, but no pus, made its appearance. Later the blood became darker and more profuse. Still later the expectorated blood assumed the appearance of clots. The discharge always came from the posterior nares, never from the anterior. The expectoration often occurred during the night. Examination was negative, but as a routine measure both antra were punctured, the right with a negative result. On needle puncture of the left antrum, however, as soon as the air

was forced into the sinus there escaped an ounce or more of apparently pure unclotted blood, the quantity of which was considerably increased on lavage with the normal, salt solution. No sign of pus either granular or en masse was present. The lining mucosa of the sinus did not appear to be greatly thickened as the lumen of the cavity was found without difficulty by the point of the needle, and the sound made by the injected air proved without question that the point was not imbedded in thickened mucosa. Irrigation was continued until the flow returned clear, after which 50 per cent alcohol with 1/2000 bichloride, sufficient to fill the sinus, was injected and the needle withdrawn. Bacteriological examination of the blood showed an abundance of streptococcus hemolyticus.

The injections were continued daily, the discharge gradually losing its hemorrhagic appearance only to assume more and more a purulent content, the total amount of secretion remaining about constant. It was therefore apparent that the irrigations were exerting little influence on the course of the disease, the character of the secretion, however, was changing from sanguineous to purulent. At the end of fifteen days, after about the same number of treatments, the blood had to all intents and purposes disappeared leaving a thin purulent, granular secretion which mixed readily with the irrigating fluid and formed with it a milky appearance.

About this time a swelling appeared upon the septum which rapidly developed into an abscess. This was incised and in a few days subsided, but was followed by a bloody discharge from the right side of the nose, the secretion hitherto had been entirely unilateral and confined to the left side. Needle puncture of the right antrum brought forth a large quantity of blood identical with that which had originally appeared from the opposite sinus. Previous to this the right side had not been affected.

The present condition of the patient is unsatisfactory in that she is fairly comfortable under bi-weekly treatments, but if untreated the disease shows a great tendency to revert to the hemorrhagic form.

This case is unique. The peculiar bloody discharge, unaccompanied by any subjective sign of inflammation with its tendency to diminish, but become purulent after irrigations, and on non-interference to revert to its original type, is puzzling, to say the least.

The advisability of a radical operation has been thoroughly discussed and finally decided upon where, it is hoped, by pathologic investigations the exact status of the infection will be determined.

DISCUSSION.

Dr. H. P. Mosher, Boston, Mass.: I recall operating a number of cases of apparent mucocele of the frontal sinus in which the sinus was filled with a sterile blood clot. These cases I never could explain. They resemble in a measure the case of Dr. Skillern. In the three cases that I have had, the modified Killian operation gave a successful result.

Report of a Case of Extradural and Subdural Abscess Following Suppurating Frontal Sinusitis and Osteomyelitis of the Frontal Bone.

By DR. JOSEPH H. BRYAN, Washington, D. C.

Male, aged 15, first seen May 6, 1919, with a history of having had a distinct swelling over the left frontal sinus, with pus under the middle turbinate on that same side in January previous. There was a temperature around 100 or 101 degrees. The left frontal sinus was opened the following day. Discharge continued and an abscess of the left upper lid developed. Operated again January 31 and a sequestrum of bone was removed from the inner wall of the sinus, leaving a perforation into the cranium and exposing the dura.

Again operated April 15, owing to continuance of the discharge. The right maxillary sinus now became infected. On one occasion a canula was inserted in the wound and the sinus washed out under mild pressure with a warm boric acid solution. Following this he complained of severe headache, numbness in the right hand and thickness of speech. This would indicate intracerebral pressure.

On May 6, when first seen by the writer, the whole of the left frontal region was markedly swollen, pitting, bloody, purulent secretion with entire absence of symptoms from his condition. Operation the following day, bone curetted and thoroughly cleansed. Packing with gauze in a solution of dichloramine T. Convalescence was long and tedious, pus flowing still two months later. On one occasion a probe first passed into the cranial cavity through the opening in the posterior wall of the sinus. In the following September the patient's general condition was good. Locally there remained a fistulous opening at the inner angle of the orbit through which the secretions continued to flow freely. The probe was introduced as formerly and an X-ray examination made with the probe in situ. Another X-ray examination was made after injecting through the sinus opening a 10 per cent solution of nitrate of thorium. This revealed a large extradural abscess. Operation, September 25, with drainage. The pus from the extradural abscess showed nonhemolytic streptococci in pure culture. By December all discharge had ceased and patient felt well. An attack of influenza in January followed. In the middle of February he became seriously ill, had a marked septic appearance, temperature 103, swelling over left frontal region associated with headache. The old wound was reopened the next day and a larger segment of bone removed, as well as necrotic bone. One week later he died.

A neurologic study of this patient's condition at this time then follows.

The bacteriologic report states that the organisms here found was the enterococcus, which occasionally becomes pathogenic.

The report of the autopsy shows the conditions as indicated in the title of the paper.

The author presents the following summary:

1. This case presents many points of interest, both from the pathologic and surgical sides. The obstinate character of the original inflammation in the frontal sinus; the exposure of the dura

in the course of one of the operations through which the infection passed to produce the extradural abscess.

2. It is unfortunate there was no bacteriological examination made from the sinus secretion at the time of the original operation.

3. The value of nitrate of thorium as an aid in differentiating between an extradural and cerebral abscess during an X-ray examination.

4. The complete relief of the osteomyelitis, generally a progrossive condition.

5. The fulminating process developing so rapidly and resulting in a subdural abscess after the extradural abscess had seemed to be relieved.

Meningitis Due to Frontal Sinus Suppuration with a Report of Three Fatal Cases.

By RALPH BUTLER, M. D., Philadelphia.

Considering the vast number of cases of sinus suppuration that exist, the number of reports of intracranial involvement from them are relatively few. A search of the literature shows the greater number of intracranial cases of otitic as compared to those of nasal origin. That these complications of sinus inflammation are not common is borne out by statistics.

The writer then quotes from the literature as to the occurrence and relative frequency of meningitis following frontal sinus disease.

Meningitis may complicate either chronic or acute sinusitis and is more common in the male during the second and third decades.

The infection may be transmitted through a congenital or a carious defect in the posterior wall of the sinus, through the veins or lymphatics, by infection of the diploe or by the formation of an osteomyelitis.

After purulent leptomeningitis has developed the prognosis is very bad. There is considerable evidence to show that the mortality has been increased by operation on the sinuses.

As there is considerable operative risk, the cosmetic results are not always satisfactory and complete cure is uncertain, many surgeons hesitate to do a radical operation unless intracranial infection is suspected or the bone is diseased. One should not hesitate beyond this point.

As illustrating the value of late operation, the writer presents the history of a 14-year-old boy who had marked proptosis of the left eyeball; the left frontal ethmoidal and maxillary sinuses were operated upon. The dura was exposed in the ehmoidal and frontal regions with local meningitis. The roof and inner wall of the orbit were largely destroyed, and staphylococci were found in pure culture. The patient has shown no evidence of extension of the intracranial involvement.

Three fatal cases are next recorded:

Case 1. Male, aged 11, had an acute inflammation of the left frontal sinus, with swelling and tenderness for about two weeks. Three months previous had an attack of influenza.

There was neither tenderness nor swelling over other sinuses, postural tests were negative and there was no abnormal secretion

in the nose or throat. The roentgenologist could not determine whether the left frontal sinus was absent or full of exudate. Blood count showed 20,000 leucocytes. The neurologist gave a negative report.

Admitted to hospital and a few hours later became unconscious, with signs of meningitis. At 2 p. m. the following day he was comatose, the neck was stiff, pupils did not react to light and accommodation, the left widely dilated, the right contracted, with hemorrhage in each fundus. A second X-ray examination showed exudate in the left frontal sinus.

The sinus was opened and found to be filled with a thick brown fluid. While the wound was being sutured the patient suddenly stopped breathing, probably from paralysis of the respiratory center. No autopsy.

Case 2. Male, aged 21. Had been kicked by a horse 14 years previously. Three months later he noticed a swelling over the inner end of the eyebrow. He had slight symptoms from this. Unilateral anosmia on that side.

Examination showed it to be a mucocele of the frontal sinus.

Removing the anterior end of the middle turbinal and opening the frontal sinus, a large cavity was found filled with thick, ropy mucus; a rubber drainage tube was inserted. On the removal of the tube the artificial duct closed and the swelling reappeared.

The wound was reopened later and a gold tube inserted, with recovery and marked improvement of his mental condition.

The patient then reappeared in four years with the tube in situ, was treated a few times, then disappeared, returning four years afterwards with a recurrence of acute symptoms. One month later he developed a typical attack of meningitis and died. No autopsy.

Case 3. Male, aged 77. The examination showed tenderness over the floor of the right frontal sinus with induration of the tissues of the upper part of the right orbit and a supraorbital fistula extending into the frontal sinus from which pus was draining. The X-ray showed marked clouding of the right frontal and roughening of its median wall with slight clouding of the right antrum and of the ethmoids on both sides.

The right middle turbinal was removed and the right antrum irrigated. Three days later an external operation was performed. The front wall containing the fistula was removed, the sinus was found filled with pulsating pus, the posterior wall was necrosed, through which the inflamed dura could be seen. At this point the operation was discontinued as the patient was doing badly. On the third day after operation the patient became irrational and had one general convulsion which was attributed to uremia. The patient died during the night.

Autopsy showed bilateral chronic suppuration of the frontal, ethmoidal and sphenoidal sinuses and of the right antrum of Highmore. Chronic suppurative meningitis with secondary atrophy of the cortical substance of the frontal lobes of the brain, estimated to be of six months' duration. Infection probably pneumococcic. Gram positive diplococci.

DISCUSSION OF DR. BRYAN'S AND DR. BUTLER'S PAPERS.

Dr. Rose Hall Skillern, Philadelphia, Pa.: I lost two cases after the Killian operation of meningitis. One point to be considered is the route by which this infection travels to the brain. In one of my cases the man died three days after operation. At autopsy the whole brain was a mass of inflammatory reaction, but no path could be traced. The cases that die are old cases who in the years have built up for themselves a kind of resistance. Operation frequently breaks this down and then they go off very quickly.

Dr. C. W. Richardson, Washington, D. C.: I believe that a latent form of meningitis exists which is started up immediately after operation. I noticed this in two of my cases.

Dr. Henry L. Swain, New Haven, Conn.: On one occasion I advised against operating on a patient sent to the hospital with meningitis and a discharging ear. The fluid from lumbar puncture contained pneumococcus, the ear secretion staphylococcus, the nose pneumococcus. The patient recovered with a succession of spinal punctures when indicated. Had the usual ear operation been done the patient would in all probability have died.

Dr. B. Alex. Randall, Philadelphia, Pa., verbally reported a case of probable noma of the nose in a man of 68, suggesting malignant disease of syphilis, but justifying neither diagnosis. Typical noma of the ala nasi later developed, but did not improve under diphtheria antitoxin.

INDEX OF THE LITERATURE.

SECTION 1.—LARYNGOLOGY AND OTOLOGY—GENERAL AND HISTORICAL.

Ballenger, Edgar G., and Elder, Omar F. Orchitis from mumps: the need of conserving the testes by incision of the tunica albuginea.
J. Am. M. Ass., Chicago, 1920—LXXV—1257.

Beck, J. C., and Deutsch, E. Interrelation between eye, ear, nose and throat with presentation of cases.
Am. J. Ophthalmol., Chicago, 1920—III—349.

Berens, C., and Uren, C. T. Effect of nose and throat infections on ocular functions of aviators.
Am. J. Ophthalmol., Chicago, 1920—III—170.

Bilancioni, G. Illumination of the throat by transparency.
Policlin., Roma, 1920—XXVII—915.

Bledsoe, R. W. Influenza: management of nose, throat and ears.
Kentucky M. J., Louisville, 1920—XVIII—289.

Brühl, G. Otologic hints for the general practitioner.
Deutsche med Wchnschr., Berl., 1920—XLVI—861, 919.

Burton, F. A. Prehistoric trephining of frontal sinus.
Calif. State J. M., San Fran., 1920—XVIII—321.

Carpenter, E. R. Surgical problems in otologic work.
Texas State J. M., Fort Worth, 1920—XVI—121.

Dufourmentel, L. Otorhinolaryngology in 1920.
Paris méd., 1920—X—176.

Finder. Rhinolaryngologic hints for general practitioner.
Deutsche med. Wchnschr., Berl., 1920—XLVI—547, 660, 691, 717, 743, 775, 802.

Friesell, H. F. Progress in dental education.
J. Am. M. Ass., Chicago, 1920—LXXV—1247.

Keyes, F. A. Institutional dentistry; results, report No. 4.
Boston M. & S. J., 1920—CLXXXIII—464.

Lanier, L. H. Essential points in successful laryngologic practice.
Laryngoscope, St. Louis, 1920—XXX—530.

Marks, H. J. Evolution of otorhinolaryngology.
Med. J. Australia, Sydney, 1920—II—331.

New, G. B. Mixed tumors of the throat, mouth and face.
J. Am. M. Ass., Chicago, 1920—LXXV—732.

Pearson, W. W. Chloroma with special reference to ear, nose and throat manifestations, with report of two cases.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—806.

Randall, B. Alexander. Trifles that count for efficiency.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—796.

Robertson, H. E. Local amyloid with special reference to socalled amyloid tumors of the tongue.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—773.

Sauer, W. E. Reactions of ear, nose and throat in syphilis.
Am. J. Syphilis, St. Louis, 1920—IV—430.

Schulze, W. Etiology of postoperative parotitis.
Zentralb. f. Gynäk., Leipz., 1920—XLIV—613.

Sonnenschein, Robert. Radium in the treatment of malignant tumors of the nose and throat: its use and possible abuse.
J. Am. M. Ass., Chicago, 1920—LXXV—860.

Thompson, J. A. Laryngologist and diseases of the lungs.
Ohio M. J., Columbus, 1920—XVI—655.

Tydings, O. Eye, ear, nose and throat in general disease.
Ark. M. Soc. J., Little Rock, 1920—XVII—74.

Von Dworzak, Z. Radium therapy in diseases of nose, ear and throat.
Colorado Med., Denver, 1920—XVII—238.

Wieder, H. S. Relationship of anatomy and physiology to pathology of nose, throat and ear.
Laryngoscope, St. Louis, 1920—XXX—543.

Yeasley, M. Recent work in otology.
Practitioner, Lond., 1920—CV—139.

SECTION 2.—RESPIRATORY SYSTEM, EXCLUSIVE OF THE EAR, NOSE AND THROAT.

Adkinson, J., and Walter, I. C. Types of streptococci found in sputum of bronchial asthmatics.
J. Med. Research, Bost., 1920—XLI—457.

Gottlieb, Mark J. Results of tests in hay fever and asthma.
J. Am. M. Ass., Chicago, 1920—LXXV—814.

Mayo, C. H. Adenoma with hyperthyroidism.
Ann. Surg., Phila., 1920—LXXII—134.

SECTION 3.—ACUTE GENERAL INFECTIONS, INCLUDING DIPHTHERIA, SCARLET FEVER AND MEASLES.

Allen, E. D. Influenza.
Iowa M. J., Des Moines, 1920—X—337.

Baez, M. Quevedo. Clinical studies on influenza.
Porto Rico M. Ass. Bull., San Juan, 1920—XIII—104.

Bardes, A. Aural aftermaths of influenza.
Med. Rec., N. Y., 1920—XCVIII—810.

Bichel, J. Influenza in Greenland.
Ugeskr. f. Laeger, Kjobenh., 1920—LXXXII—1163.

Bird, R. L. Symptoms, diagnosis and treatment of influenza.
Kentucky M. J., Louisville, 1920—XVIII—291.

Blau, A. I. Schick test, its control, and active immunization against diphtheria.
N. York M. J., 1920—CXII—279.

Bleyer, A. Concerning direct smears in diphtheria.
Am. J. Dis. Child., Chicago, 1920—445.

Boisliniere, L. C. Influenza as factor in activation of latent tuberculosis.
Am. Rev. of Tuberculosis, Balt., 1920—IV—534.

Bonar, D. S. Influenza.
Kentucky M. J., Louisville, 1920—XVIII—288.

Bosler, A. B. Diphtheria immunization.
Illinois M. J. Oak Park, 1920—XXXVIII—185.

Bradbury, S. Recurrence of influenza in a regiment.
Mil. Surgeon, 1920—XLVII—471.

Burne, W. Influenza.
Kentucky M. J., Louisville, 1920—XVIII—295.

Chaney, W. C. Treatment of fifty-one selected cases of influenza in epidemic of 1920.
Minnesota Med., St. Paul, 1920—III—436.

Clark, F. S. Influenza sequels.
Kentucky M. J., Louisville, 1920—XVIII—293.

Dorn, E. Influenza and tuberculosis.
Ztschr. f. Tuberk., Leipz., 1920—XXXI—257.

Edington, J. W. Causal organism of influenza.
Lancet, London, 1920—II—340.

Falcioni D. Immunity to influenza.
Riforma med., 1920—XXXVI—692.

Fildes, P., and McIntosh, J. Etiology of influenza.
Brit. J. Exper. Path., London, 1920—I—119, 159.

Fildes, P. New medium for growth of B. influenza.
Brit. J. Exper. Path., London, 1920—I—129.

Fishberg, M., and Boas, E. P. Influenza in tuberculosis.
Am. J. M. Sc., Phila., 1920—CLX—214.

Friedemann, U. The present influenza epidemic.
Deutsche med. Wchnschr., Berl., 1920—XLVI—283.

Gomibuchi, T. Use of diphtheria serum in treatment of influenza.
Japan Med. World, Tokyo, 1920—X—840.

Granthamhill, C. Symptomless influenzal (streptococcal) mastoiditis.
Lancet, London, 1920—II—241.

Hammond, L. J. Condition of chest in influenza.
N. York M. J., 1920—CXII—212.

Kitano, T. Results of practical application of influenza vaccine.
Japan Med. World, Tokyo, 1920—X—.

Lambert. Manifestations of diphtheria in nose and ears.
Arch. med. Belges, Liege, 1920—LXXIII—382.

Lavergne, De, and Zoeller. Schick reaction in postdiphtheric paralysis.
Bull. soc. med. de hop., Paris, 1920—XLIV—954.

Loewenhardt. Bacteriologic findings in influenza.
Deutsche med. Wchnschr., Berl., 1920—XLVI—794.

Lohrig, A. Grave diphtheria in children.
Jahrb. f. Kinderh., Berl., 1920—XCIII—49.

Lopez, J. A. Treatment of influenza.
Semana med., Buenos Aires, 1920—XXVII—535.

Majumdar, B. Influenza epidemic in Calcutta.
Indian J. Med., Calcutta, 1920—I—46.

Markel, C. Pulse, temperature and respiration in influenza.
Colorado Med., Denver, 1920—XVII—244.

Marriott, W. McKim. Postdiphtheritic paralysis of the respiratory muscles: Report of case treated by prolonged artificial respiration.
J. Am. M. Ass., Chicago, 1920—LXXV—668.

McCulloch, H. Effect of diphtheria on heart.
Am. J. Dis. Child, Chicago, 1920—XX—87.

McGill, E. L. Intubation for laryngeal diphtheria.
Virginia M. Month., Richmond, 1920—XLVII—250.

Menninger, Karl A. Influenza and hypophrenia: the interrelation of an acute epidemic infection and a chronic endemic (brain) affection.
J. Am. M. Ass., Chicago, 1920—LXXV—1044.

Morquio, L. Diphtheria and diphtheria antitoxin in Uruguay.
Rev. med. d. Uruguay, Montevideo, 1920—XXIII—260.

Opitz, H. Active immunization against diphtheria.
Jahrb. f. Kinderh., Berl., 1920—XCII—189.

Reese, G. H. Management of influenza at "Old Hickory."
Virginia M. Month., Richmond, 1920—XLVII—254.

Richardson, C. B. Influenza and its treatment with phenol.
Practitioner, Lond., 1920—CV—150.

Rosenow, E. C. Etiology of and prophylactic inoculation in influenza.
Iowa M. J., Des Moines, 1920—X—335.

St. Lawrence, Wm. Effect of tonsillectomy on the recurrence of acute rheumatic fever and chorea: a study of ninety-four children.
J. Am. M. Ass., Chicago, 1920—LXXV—1035.

Salomon, H. Iodin prophylaxis in influenza.
Deutsche med. Wchnschr., Berl., 1920—XLVI—882.

Sindoni, Maria. Bacteriologic research in influenza.
Pediatria, Naples, 1920—XXVIII—851.

Sorenson, S. T. Operations for scarlatinal otitis.
Hosp.-Tid., Kbenh., 1920—LXIII—457.

Speidel. Late results of encephalitis after influenza.
Münchener med. Wchnschr., Munich, 1920—LXVII—630.

Sur, T. Influenza epidemic in Calcutta.
Indian J. Med., Calcutta, 1920—I—57.

Tyler, W. L. Diagnosis of influenza.
Kentucky M. J., Louisville, 1920—XVIII—294.

Waters, H. G. Influenza in India, 1918-1920.
Brit. M. J., Lond., 1920—591.

Wesselhoeft, C. Orchitis in mumps.
Boston M. & S. J., 1920—CLXXXIII—425, 458, 520.

Wiesner, R. Pathogenesis of influenza.
Wien. klin. Wchnschr., 1920—XXXIII—531.

Zingher, Abraham. Accuracy of the Schick reaction: influence of variations in diphtheria toxin content in Schick outfits.
J. Am. M. Ass., Chicago, 1920—LXXV—1333.

SECTION 4.—SYPHILIS.

Davidsohn, H. Hutchinson's teeth.
Deutsche med. Wchnschr., Berl., 1920—XLVI—295.

Kranz, P. Hutchinson's teeth (a reply).
Deutsche med. Wchnschr., Berl., 1920—XLVI—773.

Sauer, W. E. Reactions of ear, nose and throat in syphilis.
Am. J. Syphilis, St. Louis, 1920—IV—430.

Schmidt, V. Syphilitic disease of nasal accessory cavities.
Hosp.-Tid., Kbenh., 1920—LXIII—544.

SECTION 5.—TUBERCULOSIS.

Boisliniere, L. C. Influenza as factor in activation of latent tuberculosis.
Am. Rev. of Tuberculosis, Balt., 1920—IV—534.

Dorn, E. Influenza and tuberculosis.
Ztschr. f. Tuberk., Leipz., 1920—XXXI—257.

Fishberg, M., and Boas, E. P. Influenza in tuberculosis.
Am. J. M. Sc., Phila., 1920—CLX—214.

Mieres, J. F. Exophthalmic goiter in the tuberculous.
Semana med., Buenos Aires, 1920—XXVII—507.

Sergent, E. Exophthalmic goiter mistaken for tuberculosis.
Paris méd., 1920—X—80.

Sloan, E. P. Tubercular goiter patient.
Illinois M. J., Oak Park, 1920—XXXVIII—144.

SECTION 6.—ANATOMY, PHYSIOLOGY AND PATHOLOGY.

Adkinson, J., and Walter, I. C. Types of streptococci found in sputum of bronchial asthmatics.
J. Med. Research, Bost., 1920—XLI—457.

Canelli, A. F. Anatomy and pathology of the thymus in young children.
Pediatria, Napoli, 1920—XXVIII—573.

Floyd, C. Study of streptococci obtained from mouth in cases of chorea.
J. Med. Research, Bost., 1920—XLI—467.

Kellert, E. Pathologic histology of tonsils containing hemolytic streptococci.
J. Med. Research, Bost., 1920—XLI—387.

Loewenhardt. Bacteriologic findings in influenza.
Deutsche med. Wchnschr., Berl., 1920—XLVI—794.

Meyer, Jacob. Types of pneumococci in the throats of one hundred normal persons.
J. Am. M. Ass., Chicago, 1920—LXXV—1268.

Marine, D. Physiology of normal thyroid and physiology of thyroid in exophthalmic goiter.
Ohio M. J., Columbus, 1920—XVI—735.

Sindoni, Maria. Bacteriologic research in influenza.
Pediatria, Naples, 1920—XXVIII—851.

Tanaka, F., and Yoshida, C. Vital fixation of auricular organs and staining of nerves.
Japan Med. World, Tokyo, 1920—X—.

Wieder, H. S. Relationship of anatomy and physiology to pathology of nose, throat and ear.
Laryngoscope, St. Louis, 1920—XXX—543.

Wood, G. B. Anatomy, physiology and pathology of tonsillar structures in relation to cryptogenic infections.
Med. Rec., N. Y., 1920—XCVIII—593.

SECTION 7.—EXTERNAL NOSE.

Carter, W. W. Nasal deformities due to submucous operation; their prevention and treatment.
Med. Rec., N. Y., 1920—XCVIII—808.

Chubb, G. New method in rhinoplasty.
Lancet, London, 1920—II—354.

Cohen, L. Correct rhinoplasty.
Surg., Gynec. & Obst., Chicago, 1920—XXXI—412.

Hartzell, M. B. Lupus erythematosus and focal infection.
Arch. of dermat. and syphil., Chicago, 1920—II—441.

Oppenheimer, S. Condemnatory note on use of paraffin in cosmetic rhinoplasty.
Laryngoscope, St. Louis, 1920—XXX—595.

Oppenheimer, S. Implantation methods in cosmetic rhinoplasty.
Boston M. & S. J., 1920—CLXXXIII—329.

SECTION 8.—NASAL CAVITIES.

Agar, M. Method of treating hay fever and paroxysmal rhinorrhea.
Brit. M. J., London, 1920—II—125.

Caldera, C. Etiology of ozena.
Ann. d'ig., Rome, 1920—XXX—168.

Carter, W. W. Nasal deformities due to submucous operation; their prevention and treatment.
Med. Rec., N. Y., 1920—XCVIII—808.

Gottlieb, Mark J. Results of tests in hay fever and asthma.
J. Am. M. Ass., Chicago, 1920—LXXV—814.

Heermann. Treatment of hay fever.
Deutsche med. Wchnschr., Berl., 1920—XLVI—211.

Imperatori, C. J. Apparatus for irrigating nasal cavities, useful in home treatment.
Laryngoscope, St. Louis, 1920—XXX—550.

Meller. Relation of retrobulbar neuritis to nasal cavity.
Wien. klin. Wchnschr., 1920—XXXIII—205.

Nagel, C. S. G. Congenital atresia of lacrimal duct.
Am. J. Ophth., Chicago, 1920—III—406.

Patton, W. T. Simplified technic for local anesthesia of tonsils; intranasal surgery without packing.
South. M. J., Birmingham, Ala., 1920—XIII—750.

Potts, J. B. Nasal infection basis of certain ocular lesions.
Am. J. Ophthalmol., Chicago, 1920—III—195.

Walker, I. Chandler. Frequent causes and the treatment of perennial hay fever.
J. Am. M. Ass., Chicago, 1920—LXXV—782.

Walter, Will. Inoculation against hay fever.
J. Am. M. Ass., Chicago, 1920—LXXV—670.

Wiener, Meyer and Sauer, W. E. A new operation for the relief of dacryocystitis through the nasal route.
J. Am. M. Ass., Chicago, 1920—LXXV—868.

SECTION 9.—ACCESSORY SINUSES.

Burton, F. A. Prehistoric trephining of frontal sinus.
Calif. State J. M., San Fran., 1920—XVIII—321.

Dunning, Henry S. Surgical treatment of chronic maxillary sinusitis of oral origin.
J. Am. M. Ass., Chicago, 1920—LXXV—1391.

Ellett, E. C. Optic neuritis, associated with disease of the nasal sinuses; report of two cases.
J. Am. M. Ass., Chicago, 1920—LXXV—805.

Harter, J. H. Diseases of ethmoid and sphenoid sinuses.
Northwest Med., Seattle, 1920—XIX—199.

Liebault, G. Acute frontal sinusitis and ptosis.
Bull. méd., Par., 1920—XXXIV—815.

Loeb, H. W. Two cases of blindness relieved by ethmoid exenteration; case of keratoiritis due to tonsil infection.
J. Missouri M. Ass., St. Louis, 1920—XVII—409.

Meller. Relation of retrobulbar neuritis to nasal cavity.
Wien. klin. Wchnschr., 1920—XXXIII—205.

Novitsky, J. Dead teeth and antral pathology.
Illinois M. J., Oak Park, 1920—XXXVIII—143.

Patton, W. T. Simplified technic for local anesthesia of tonsils; intranasal surgery without packing.
South. M. J., Birmingham, Ala., 1920—XIII—750.

Potts, J. B. Nasal infection basis of certain ocular lesions.
Am. J. Ophthalmol., Chicago, 1920—III—195.

Schmidt, V. Syphilitic disease of nasal accessory cavities.
Hosp.-Tid., Kbenh., 1920—LXIII—544.

Skillern, R. H. Ethmoid problem.
Texas State J. M., Fort Worth, 1920—XVI—116.

Unger, M. New instrument and method for washing and draining nasal sinuses.
Laryngoscope, St. Louis, 1920—XXX—561.

Welty, Cullen, F. Closure of fistulous openings through alveolar process into antrum of Highmore.
J. Am. M. Ass., Chicago, 1920—LXXV—867.

White, L. E. Diagnosis of accessory sinus disease causing loss of vision.
Laryngoscope, St. Louis, 1920—XXX—551.

SECTION 10.—PHARYNX, INCLUDING TONSILS AND ADENOIDS.

Anderson, H. B., Mann, R. W., and Sharpe, N. C. Chronic tonsillar infections.
Med. Rec., N. Y., 1920—XCVIII—589.

Bernstein, E. J. Sluder operation.
J. Mich. M. Soc., Grand Rapids, 1920—XIX—448.

Boyd, F. D. General vs. local faucial tonsil removal.
South. M. J., Birmingham, Ala., 1920—XIII—748.

Boyd, F. Plea for more careful tonsil and adenoid operation.
Texas State J. M., Fort Worth, 1920—XVI—131.

Brüggemann, A. Plaut-Vincent angina.
München. med. Wchnschr., 1920—LXII—772.

Flores, A. Mycosis of pharynx and larynx.
Cron. med., Lima., 1920—XXXVII—225.

Frantz, C. P. Tonsils cases I have met.
Iowa M. J., Des Moines, 1920—X—309.

Ganley, J. E. Vincent's angina-stomatitis.
Boston M. & S. J., 1920—CLXXXIII—466.

Hirsch. Treatment of Plaut-Vincent angina with arsphenamin.
München. med. Wchnschr., Munich, 1920—LXVII—718.

Kellert, E. Pathologic histology of tonsils containing hemolytic streptococci.
J. Med. Research, Bost., 1920—XLI—387.

Key, S. N. Status of tonsillectomy in Texas.
Texas State J. M., Fort Worth, 1920—XVI—130.

Lapat, Wm. Catheterization of eustachian tubes through the mouth.
J. Am. M. Ass., Chicago, 1920—LXXV—1498.

Lapsley, R. M. Diseased tonsils.
Iowa M. J., Des Moines, 1920—X—308.

McReynolds, G. S. Tonsil operation, with special reference to hemorrhage control.
Texas State J. M., Fort Worth, 1920—XVI—132.

Meyer, Jacob. Types of pneumococci in the throats of one hundred normal persons.
J. Am. M. Ass., Chicago, 1920—LXXV—1268.

Neugebauer, G. Angino ludovici.
Deutsche. med. Wchnschr., Berl., 1920—XLVI—942.

Orendorff, Otis. Foreign body in nasopharynx.
J. Am. M. Ass., Chicago, 1920—LXXV—1343.

Patton, W. T. Simplified technic for local anesthesia of tonsils; intranasal surgery without packing.
South. M. J., Birmingham, Ala., 1920—XIII—750.

Quackenbos, M. Chronic peritonsillar abscess.
N. York M. J., 1920—LXII—193.

Ramos, A. Aurelio. Pneumococcus tonsillitis.
Arch. espan. de Pediatria, Madrid, 1920—IV—273.

Rich, A. B. Innervation of tensor veli palatini and levator veli palatini muscles.
Johns Hopkins Hosp. Bull., Balt., 1920—XXXI—305.

Richardson, Charles W. Acute abscess of the lateral wall of the laryngopharynx.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—804.

Rosenblatt, S. Simple bloodless tonsillectomy, with local anesthesia.
Laryngoscope, St. Louis, 1920—XXX—576.

St. Lawrence, Wm. Effect of tonsillectomy on the recurrence of acute rheumatic fever and chorea: a study of ninety-four children.
J. Am. M. Ass., Chicago, 1920—LXXV—1035.

Shapiro, A. F. Instrument for simplifying tonsillectomy by snare.
N. York M. J., 1920—CXII—681.

Sparata, L. B. Tonsillectomies.
Kansas M. Soc. J., Topeka, 1920—XX—221.

Thompson, W. R. Abortive treatment of peritonsillar infection.
Texas State J. M., Fort Worth, 1920—XVI—129.

Trotter, W. Method of lateral pharyngotomy for exposure of large growths in epilaryngeal region.
J. Laryngol., Lon., 1920—XXXV—289.

Voss, J. Vincent's angina.
Norsk Mag. f. Laegevidensk., Kristiania, 1920—XXCI—778.

Wood, G. B. Anatomy, physiology and pathology of tonsillar structures in relation to cryptogenic infections.
Med. Rec., N. Y., 1920—XCVIII—593.

Yorke, C. Anesthesia in tonsil and adenoid operations.
British M. J., London, 1920—318.

SECTION 11.—LARYNX.

Flores, A. Mycosis of pharynx and larynx.
Cron. med., Lima., 1920—XXXVII—225.

Garland, J., and White, P. D. Paralysis of left recurrent laryngeal nerve associated with mitral stenosis.
Arch. Int. Med., Chicago, 1920—XXVI—343.

Goodloe, A. E. Laryngo-tracheo bronchoscopy.
Tenn. M. Ass. J., Nashville, 1920—XIII—141.

Hofer, G. Chronic stenosis of larynx and trachea.
Kien. klin. Wchnschr. Vienna, 1920—XXXIII—515.

Jackson, C. Peroral endoscopy and laryngeal surgery.
Laryngoscope, St. Louis, 1920—XXX—520.

MacKenzie, G. W. Motor neuroses of larynx.
Laryngoscope, St. Louis, 1920—XXX—585.

McGill, E. L. Intubation for laryngeal diphtheria.
Virginia M. Month., Richmond, 1920—XLVII—250.

Portmann, G. Technic and indications for biopsy of the larynx.
Paris méd., 1920—X—185.

Richardson, Charles W. Acute abscess of the lateral wall of the laryngopharynx.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—804.

Rosenthal, G. Technic for intercricothyroid injections.
Paris méd., 1920—X—521.

Stern, H. Laryngectomy and retraining of the voice.
Wien. klin. Wchnschr., 1920—XXXIII—540.

Symonds, C. J. Total laryngectomy: indications for and results of operation.
J. Laryngol., Lond., 1920—XXXV—257.

Trotter, W. Method of lateral pharyngotomy for exposure of large growths in epilaryngeal region.
J. Laryngol., Lon., 1920—XXXV—289.

SECTION 12.—TRACHEA AND BRONCHI.

Bard, L. Compression of trachea from aerophagia with idiopathic dilatation of esophagus.
Arch. de mal. de l'appar. digest., Paris, 1920—X—449.

Burgess, J. L. Report of selected cases of foreign bodies in bronchi and esophagus.
Texas State J. M., Fort Worth, 1920—XVI—128.

Elliott, J. H. Dilatation of bronchi.
Med. Rec., N. Y., 1920—XCVIII—253.

Freudenthal, W. Bronchoperiscope.
Laryngoscope St. Louis, 1920—XXX—527.

Goodloe, A. E. Laryngo-tracheo bronchoscopy.
Tenn. M. Ass. J., Nashville, 1920—XIII—141.

Hofer, G. Chronic stenosis of larynx and trachea.
Kien. klin. Wchnschr. Vienna, 1920—XXXIII—515.

Mitchell, W. Case of broncho-esophageal fistula.
Arch. Radiol. & Electroth., Lond., 1920—49.

SECTION 13.—VOICE AND SPEECH.

Head, H. Aphasia and kindred disorders of speech.
Brain, London, 1920—XLIII—87.

Richardson, C. W. Demonstration of reconstruction of section of defects of hearing and speech.
Laryngoscope, St. Louis, 1920—XXX—487.

Stern, H. Laryngectomy and retraining of the voice.
Wien. klin. Wchnschr., 1920—XXXIII—540.

Venables, J. F. Stammering.
Seala Hayne Neurological Studies, London, 1920—I—331.

SECTION 14.—ESOPHAGUS.

Axhausen, G. Reconstruction of esophagus.
Beit. z. klin. Chir., Tübing., 1920—CXX—163.

Bard, L. Compression of trachea from aerophagia with idiopathic dilatation of esophagus.
Arch. de mal. de l'appar. digest., Paris, 1920—X—449.

Burgess, J. L. Report of selected cases of foreign bodies in bronchi and esophagus.
Texas State J. M., Fort Worth, 1920—XVI—128.

Forbes, H. H. Use of radium in esophageal cancer.
N. York M. J., 1920—CXII—568.

Mitchell, W. Case of broncho-esophageal fistula.
Arch. Radiol. & Electroth., Lond., 1920—49.

Oettinger and Caballero. Mega-esophagus.
Bull. Soc. med. d. hop., Paris, 1920—XLIV—1052.

Ringsdorff, H. Esophageal stenosis with multiple spasms.
Monatschr. f. Kinderh., Berlin, 1920—XIII—131.

Rossi, F. Foreign body in esophagus.
Policlin., Rome, 1920—XXVII—696.

SECTION 15.—ENDOSCOPY.

Burgess, J. L. Report of selected cases of foreign bodies in bronchi and esophagus.
Texas State J. M., Fort Worth, 1920—XVI—128.

Freudenthal, W. Bronchoperiscope.
Laryngoscope St. Louis, 1920—XXX—527.

Goodloe, A. E. Laryngo-tracheo bronchoscopy.
Tenn. M. Ass. J., Nashville, 1920—XIII—141.

Jackson, C. Peroral endoscopy and laryngeal surgery.
Laryngoscope, St. Louis, 1920—XXX—520.

SECTION 16.—EXTERNAL EAR AND CANAL.

Carpenter, E. R. Surgical problems in otologic work.
Texas State J. M., Fort Worth, 1920—XVI—121.

Moraes, E. The ear and the hearing.
Brazil med., Rio de Jan., 1920—XXXIV—460.

Neville, S. Tetanus due to ear infection.
China M. J., Shanghai, 1920—XXXIV—381.

Romanos, Mesonero. Herpes zoster of ear and neck, with peripheral facial paralysis.
Siglo med., Madrid, 1920—LXVII—401.

Tanaka, F., and Yoshida, C. Vital fixation of auricular organs and staining of nerves.
Japan Med. World, Tokyo, 1920—X—.

Wood, A. Moth in ear.
Lancet, London, 1920—II—600.

SECTION 17.—MIDDLE EAR, INCLUDING TYMPANIC MEMBRANE AND EUSTACHIAN TUBE.

Bacher, J. A. Surgical treatment of acute otitis media in children, with report of fifty consecutive cases.
Calif. State J. M., San Fran., 1920—XVIII—327.

Bardes, A. Aural aftermaths of influenza.
Med. Rec., N. Y., 1920—XCVIII—810.

Carpenter, E. R. Surgical problems in otologic work.
Texas State J. M., Fort Worth, 1920—XVI—121.

Cecilia, J. Santa. Eye sign of facial paralysis.
Bravil med., Rio de Jan., 1920—XXXIV—444.

Frey, H., and Orzechowski, K. Otosclerosis in relation to tetany.
Wien. klin. Wchnschr., 1920—XXXIII—697, 754.

Guttman, J. Case of carcinoma of middle ear.
N. York M. J., 1920—CXII—675.

Lapat, Wm. Catheterization of eustachian tubes through the mouth.
J. Am. M. Ass., Chicago, 1920—LXXV—1498.

Leegard, F. Otogenous pyemia, sinus phlebitis and sinus thrombosis.
Norsk Mag. f. Laegevidensk., Kristiania, 1920—XXCI—745.

McKenzie, D. Aqueduct of fallopius and facial paralysis.
J. Laryngol., Lond., 1920—XXXV—244, 271, 296.

Moraes, E. The ear and the hearing.
Brazil med., Rio de Jan., 1920—XXXIV—460.

Neville, S. Tetanus due to ear infection.
China M. J., Shanghai, 1920—XXXIV—381.

Sorenson, S. T. Operations for scarlatinal otitis.
Hosp.-Tid., Kbenh., 1920—LXIII—457.

Tanaka, F., and Yoshida, C. Vital fixation of auricular organs and staining of nerves.
Japan Med. World, Tokyo, 1920—X—.

SECTION 18.—MASTOID PROCESS.

Bardes, A. Aural aftermaths of influenza.
Med. Rec., N. Y., 1920—XCVIII—810.

Barnhill, J. F. Anomalous sigmoid sinus thrombosis; report of cases.
Med. Rec., N. Y., 1920—XCVIII—388.

Carpenter, E. R. Surgical problems in otologic work.
Texas State J. M., Fort Worth, 1920—XVI—121.

Dittman, G. C. Paralysis of abducens nerve secondary to mastoiditis.
Minnesota Med., St. Paul, 1920—III—439.

Glogau, O. Mastoidectomy (perisinus abscess, exposure of dura) followed by attacks of toxic insanity; recovery.
Laryngoscope, St. Louis, 1920—XXX—566.

Granthamhill, C. Symptomless influenzal (streptococcal) mastoiditis.
Lancet, London, 1920—II—241.

Hill, Frederick T. Lateral sinus thrombosis, with report of seven cases.
Ann. Otol., Rhinol. and Laryngol., St. Louis, 1920—XXIX—829.

Jones, W. D. Two atypical cases of acuet mastoiditis.
Texas State J. M., Fort Worth, 1920—XVI—123.

Jordan, L. G. Mastoid cases.
Mil. Surgeon, 1920—XLVII—310.

Leegard, F. Otogenous pyemia, sinus phlebitis and sinus thrombosis.
Norsk Mag. f. Laegevidensk., Kristiania, 1920—XXCI—745.

Molinari, G. Mastoid versus vertebral suppuration.
Riforma med., Naples, 1920—XXXVI—550.

Robinson, J. A. Cavernous sinus thrombosis following a secondary mastoidectomy.
Laryngoscope, St. Louis, 1920—XXX—574.

Rott, Otto M. Concerning the question of jugular ligation in sinus thrombosis.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—820.

Salinger, S. Mastoiditis without tympanic involvement.
Laryngoscope, St. Louis, 1920—XXX—573.

Salinger, Samuel. Primary periostitis of the mastoid.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—943.

Stoops, R. P. Mastoidectomy in presence of erysipelas.
Nebraska State M. J., Norfolk, 1920—V—217.

SECTION 19.—INTERNAL EAR.

Aynesworth, H. T. Vertigo.
Texas State M. J., Fort Worth, 1920—XVI—243.

Cantaloube, P. The function of the vestibule.
Revue neurologique, Paris, 1920—XXVII—305.

Crane, C. G. Neurootology.
Ann. Otol., Rhinol. and Laryngol., St. Louis, 1920—XXIX—879.

Edmunds, T. W., and Dudley, G. B., Jr. Case of mastoiditis, with necrosis of bony lamina covering sigmoid portion of lateral sinus.
Virginia M. Month., Richmond, 1920—XLVII—317.

Frey, H., and Orzechowski, K. Otosclerosis in relation to tetany.
Wien. klin. Wchnschr., 1920—XXXIII—697, 754.

Grahe, K. The internal ear in lethargic encephalitis.
Münchener med. Wchnschr., Munich, 1920—LXVII—629.

Heitger, Joseph D. The present status of neurootology from the borderline standpoint.
J. Am. M. Ass., Chicago, 1920—LXXV—800.

Kerrison, P. D. Vestibular vertigo; prognosis in different types of cases. Reports of cases.
Ohio M. J., Columbus, 1920—XVI—726.

Lyons, Horace Raymond. Barany tests in supratentorial tumors proved by operation or necropsy.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—898.

Martel, Fred J., and Jones, Isaac H. The education of the vestibular sense.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—859.

McKenzie, D. Aqueduct of fallopius and facial paralysis.
J. Laryngol., Lond., 1920—XXXV—244, 271, 296.

Milesi, G. Auditory neuritis in meningitis.
Policlin., Roma, 1920—XXVII—924.

Moraes, E. The ear and the hearing.
Brazil med., Rio de Jan., 1920—XXXIV—460.

Pearson, W. W. Vestibular manifestations in neurologic cases.
Iowa M. J., Des Moines, 1920—X—303.

Scott, S. Ear in relation to certain disabilities in flying.
J. Laryngol., Lond., 1920—XXXV—225.

Tanaka, F., and Yoshida, C. Vital fixation of auricular organs and staining of nerves.
Japan Med. World, Tokyo, 1920—X—.

Vail, H. H. Studies by Barany rotation and caloric tests of tumors of nervus acusticus.
Laryngoscope, St. Louis, 1920—XXX—505.

SECTION 20.—DEAFNESS AND DEAFMUTISM, AND TESTS FOR HEARING.

Aymard, J. L. Problem of the deaf.
South African M. Rec., Cape Town, 1920—XVIII—243.

Booth, F. W. Education of deaf.
Nebraska State M. J., Norfolk, 1920—V—261.

Goldstein, M. A. Deaf child.
Laryngoscope, St. Louis, 1920—XXX—479.

Krukenberg, H. Operative treatment for deafness.
München. med. Wchnschr., 1920—LXVII—835.

Love, J. K. Origin of sporadic congenital deafness.
J. Laryngol., Lond., 1920—XXXV—263.

Moraes, E. The ear and the hearing.
Brazil med., Rio de Jan., 1920—XXXIV—460.

Peck, A. W. How the deafened rebuild their lives.
Laryngoscope, St. Louis, 1920—XXX—490.

Richardson, C. W. Demonstration of reconstruction of section of defects of hearing and speech.
Laryngoscope, St. Louis, 1920—XXX—487.

Samuelson, E. E. Ears and job.
Laryngoscope, St. Louis, 1920—XXX—501.

Seligmann, A. A case of deafness in infantile scurvy.
Monatschr. f. Kinderh., Berlin, 1920—XVIII—221.

Storey, J. de R. Psychology of deafened people from a layman's point of view.
Laryngoscope, St. Louis, 1920—XXX—496.

Wright, J. D. The deaf.
Laryngoscope, St. Louis, 1920—XXX—597.

Yearsley, M. Can acquired deafness lead to congenital deafness?
J. Laryngol., Lond., 1920—XXXV—270.

SECTION 21.—FOREIGN BODIES IN THE NOSE, THROAT AND EAR.

Burgess, J. L. Report of selected cases of foreign bodies in bronchi and esophagus.
Texas State J. M., Fort Worth, 1920—XVI—128.

Goodloe, A. E. Laryngo-tracheo bronchoscopy.
Tenn. M. Ass. J., Nashville, 1920—XIII—141.

Orendorff, Otis. Foreign body in nasopharynx.
J. Am. M. Ass., Chicago, 1920—LXXV—1343.

Rossi, F. Foreign body in esophagus.
Policlin., Rome, 1920—XXVII—696.

Wood, A. Moth in ear.
Lancet, London, 1920—II—600.

SECTION 22.—ORAL CAVITY, INCLUDING TONGUE, PALATE AND INFERIOR MAXILLARY.

Arnone, L. Prosthesis for cleft palate in nurslings.
Riv. di clin. pediat., Florence, 1920—XVIII—347.

Ballenger, Edgar G., and Elder, Omar F. Orchitis from mumps: the need of conserving the testes by incision of the tunica albuginea.
J. Am. M. Ass., Chicago, 1920—LXXV—1257.

Bercher, J. Indications and technic for blocking inferior dental nerve.
Paris méd., 1920—X—193.

Blair, V. P. Treatment of advanced carcinoma of mouth.
J. Missouri M. Ass., St. Louis, 1920—XVII—395.

Bonnet-Roy, F. Treatment of ranula.
Paris méd., 1920—X—184.

Bowen, C. F. Fractures of bones of face.
Am. J. Roentgenol., N. York, 1920—VII—350.

Brown, G. V. I. Plastic work in surgery of the jaw.
Wisconsin M. J., Milwaukee, 1920—XX—143.

Cobb, C. M. Tooth brush a cause of repeated infections of mouth.
Boston M. & S. J., 1920—CXXVIII—263.

Cole, P. P. Surgical treatment of malignant disease of lip and jaw.
Lancet, Lond., 1920—II—845.

Comby, J. Scurvy in infants.
Medicine Paris, 1920—I—673.

Courbon, P. Recurring dislocation of jaw from bullet close to angle.
Revue neurologique, Paris, 1920—XXVII—337.

Cushing, H. Experiences with 332 Gasserian operations.
Am. J. M. Sc., Phila., 1920—CLX—157.

Davidsohn, H. Hutchinson's teeth.
Deutsche med. Wchnschr., Berl., 1920—XLVI—295.

Dorrance, Geo. M. Epithelial inlays versus skin or mucous membrane flaps for replacing lost mucous membrane in the mouth.
J. Am. M. Ass., Chicago, 1920—LXXV—1179.

Dunning, Henry S. Surgical treatment of chronic maxillary sinusitis of oral origin.
J. Am. M. Ass., Chicago, 1920—LXXV—1391.

Fargin-Fayolle, P. Stomatology in 1920.
Paris méd., 1920—X—188.

Floyd, C. Study of streptococci obtained from mouth in cases of chorea.
J. Med. Research, Bost., 1920—XLI—467.

Friesell, H. F. Progress in dental education.
J. Am. M. Ass., Chicago, 1920—LXXV—1247.

Ganley, J. E. Vincent's angina-stomatitis.
Boston M. & S. J., 1920—CLXXXIII—466.

Gompertz, L. M. Relation of teeth to general medicine.
Med. Rec., N. Y., 1920—XCVIII—217.

Guthrie, Haidee Weeks. A dental clinic for children in a settlement.
J. Am. M. Ass., Chicago, 1920—LXXV—1245.

Hallez, G. L. Scurvy in infants.
Medecine, Paris, 1920—I—123.

Harms, C. Etiology of actinomycosis of the tongue.
Munchen. med. Wchnschr., 1920—LXVII—903.

Hatton, Edward H. Adenoma of mucous glands of mouth, and macrocheilia.
J. Am. M. Ass., Chicago, 1920—LXXV—1176.

Hochschild, H. Chronic large parotid glands in children.
Jahrb. f. Kinderh., Berl., 1920—XCII—360.

Jacobson, A. C. Practical mouth hygiene.
Boston M. & S. J., 1920—CXXCIII—264.

Jamieson, J. K., and Dobson, J. F. Lymphatics of tongue: particular reference to removal of glands in cancer of tongue.
Brit. J. Surg., Lond., 1920—VIII—80.

Kranz, P. Hutchinson's teeth (a reply).
Deutsche med. Wchnschr., Berl., 1920—XLVI—773.

Lain, Everett S. A clinical study of epithelioma of the lower lip.
J. Am. M. Ass., Chicago, 1920—LXXV—1052.

Leulero. Radiography of lower jaw.
J. de radiol. et d'electrol., Paris, 1920—IV—36.

Macht, David I. Benzyl alcohol for toothache.
J. Am. M. Ass., Chicago, 1920—LXXV—1205.

Miller, A. L. Gradual reduction of fractures of the maxilla and mandible.
J. Am. M. Ass., Chicago, 1920—LXXV—1255.

Newall, W. A. Case of infantile scurvy.
Am. J. Roentgenol., N. Y., 1920—VII—371.

Novitsky, J. Dead teeth and antral pathology.
Illinois M. J., Oak Park, 1920—XXXVIII—143.

Peters, W. Operative treatment of carcinoma of the lip.
Zentralb. f. Chir., Leipz., 1920—XLVII—564.

Potts, H. A. Treatment of comminuted fractures of the mandible.
J. Am. M. Ass., Chicago, 1920—LXXV—1178.

Robertson, H. E. Local amyloid with special reference to socalled amyloid tumors of the tongue.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—773.

Schulze, W. Etiology of postoperative parotitis.
Zentralb. f. Gynäk., Leipz., 1920—XLIV—613.

Seligmann, A. A case of deafness in infantile scurvy.
Monatschr. f. Kinderh., Berlin, 1920—XVIII—221.

Strettiner, H. Note on operation for harelip.
Zentralbl. f. Chir., Leipz., 1920—XLVII—952.

Thompson, J. E. Relationship between ranula and branchiogenetic cysts.
Ann. Surg., Phila., 1920—LXXII—164.

Tousey, S. Dental infection.
N. York M. J., 1920—CXII—353.

Welty, Cullen, F. Closure of fistulous openings through alveolar process into antrum of Highmore.
J. Am. M. Ass., Chicago, 1920—LXXV—867.

Wesselhoeft, C. Orchitis in mumps.
Boston M. & S. J., 1920—CLXXXIII—425, 458, 520.

SECTION 23.—FACE.

Cole, P. P. Surgical treatment of malignant disease of lip and jaw.
Lancet, Lond., 1920—II—845.

Hochschild, H. Chronic large parotid glands in children.
Jahrb. f. Kinderh., Berl., 1920—XCII—360.

Lain, Everett S. A clinical study of epithelioma of the lower lip.
J. Am. M. Ass., Chicago, 1920—LXXV—1052.

Peters, W. Operative treatment of carcinoma of the lip.
Zentralb. f. Chir., Leipz., 1920—XLVII—564.

Zacherl, H. Malformations of the face.
Arch. f. klin. Chir., Berl., 1920—CXIII—374.

SECTION 24.—CERVICAL GLANDS AND DEEPER NECK STRUCTURES.

Geymüller, E. Actinomycosis of neck and brain.
Deutsche Ztschr. f. Chir., Leipz., 1920—CLI—200.

Jones, E. G. Surgery of the neck.
Med. Rec., N. Y., 1920—XCVIII—386.

Romanos, Mesonero. Herpes zoster of ear and neck, with peripheral facial paralysis.
Siglo med., Madrid, 1920—LXVII—401.

Thompson, J. E. Relationship between ranula and branchiogenetic cysts.
Ann. Surg., Phila., 1920—LXXII—164.

SECTION 25.—THYROID AND THYMUS.

Alamraine, A. Surgical anatomy of nerves of the thyroid.
Rev. de chir., Par., 1920—XXXIX—403.

Berkeley, W. N. Preliminary report on new method for clinical diagnosis of toxic thyroid states; serologic technic.
Ohio M. J., Columbus, 1920—XVI—754.

Bingham, G. H., and Richards, G. E. Corelation of results of treatment of goiter by surgical and roentgen ray methods.
Canad. M. Ass. J., Toronto 1920—X—988.

Canelli, A. F. Anatomy and pathology of the thymus in young children.
Pediatria, Napoli, 1920—XXVIII—573.

Cottis, G. W. Practical points in goiter surgery.
N. York State J. M., 1920—XX—290.

Coulaud, E. Thyroid and pituitary organotherapy.
Bull. méd., Par., 1920—XXXIV—859.

Crile, G. W. Special consideration of toxic adenoma in relation to exophthalmic goiter.
Ann. Surg., Phila., 1920—LXXII—141.

Crotti, A. Etiology and pathology of exophthalmic goiter: their bearing on prevention, prognosis and treatment.
Ohio M. J., Columbus, 1920—XVI—738.

Förster, W. Nerve blocking for goiter operation.
Munchen. med. Wchnschr., 1920—LXVII—904.

Frazier, C. H. Management of toxic goiter from surgical point of view.
Ann. Surg., Phila., 1920—LXXII—155.

Freeman, L. "Tourniquet operation" in toxic and other goiters.
Ann. Surg., Phila., 1920—LXXII—161.

Fussell, M. H. Diagnosis and treatment of hyperthyroidism.
N. York M. J., 1920—CXII—205.

Gandy, C., and Piedelievre, R. Cancer of the thymus.
Bull. soc. méd. d. hop., Paris, 1920—XLIV—867.

Garibaldi, A. The thyroid and production of antibodies.
Cron. med., Lima, 1920—XXXVII—200.

Goetsch, Emil. Diagnosis and treatment of thyroid disease based on use of epinephrin hypersensitiveness test.
N. York State J. M., 1920—XX—282.

Goetsch, E. Disorders of thyroid: hypersensitiveness test with special reference to "diffuse adenomatosis" of thyroid.
Endocrinology, Los Angeles, 1920—IV—389.

Hoppe, H. H. Treatment of hyperthyroidism with corpus luteum: a second report.
Ohio M. J., Columbus, 1920—XVI—749.

Ishihara, M. Effect of experimental extirpation of thyroid body.
Bull. Naval Med. Ass. Japan, Tokyo, 1920—I.

Jaeger, H. Parathyroid implants in postoperative tetany.
Zentralb. f. Chir., Leipz., 1920—XLVII—565.

Janney, N. W., and Henderson, H. E. Diagnosis and treatment of hypothyroidism.
Arch. Int. Med., Chicago, 1920—XXVI—297.

Johnston, C. H. Diagnosis of hyperthyroidism.
J. Mich. M. Soc., Grand Rapids, 1920—XIX—456.

Juarros, C. Hyperthyroidism and the Bloch syndrome.
Siglo med., Madrid, 1920—LXVI—417.

Judd, E. S. Results of operation for adenoma with hyperthyroidism and exophthalmic goiter.
Ann. Surg., Phila., 1920—LXXII—145.

Judd, E. S. Results of surgical treatment of exophthalmic goiter.
N. York State J. M., 1920—XX—287.

Kottmann, K. Colloid chemistry and the thyroid problem.
Schweiz. med. Wchnschr., Basel, 1920—L—644.

Larson, J. A. Further evidence on functional correlation of hypophysis and thyroid.
American J. Physiol., Baltimore, 1920—LIII—89.

Loeb, L. Compensatory hypertrophy of thyroid. V. Effect of administration of thyroid, thymus gland and tethelin and meat diet on hypertrophy of thyroid in guinea pigs.
J. Med. Research, Bos., 1920—XLII—77.

Loeb, L. Studies on compensatory hypertrophy of thyroid gland.
J. Med. Research, Bost., 1920—XLI—481.

Mayo, C. H. Adenoma with hyperthyroidism.
Ann. Surg., Phila., 1920—LXXII—134.

Mieres, J. F. Exophthalmic goiter in the tuberculous.
Semana med., Buenos Aires, 1920—XXVII—507.

Marine, D. Physiology of normal thyroid and physiology of thyroid in exophthalmic goiter.
Ohio M. J., Columbus, 1920—XVI—735.

Marine, D., and Kimball, O. P. Goiter survey work in Ohio; incidence of simple goiter in school children of Cleveland, Akron and Warren.
Ohio M. J., Columbus, 1920—XVI—757.

Moore, R. F. Exophthalmos and limitation of eye movements of exophthalmic goiter.
Lancet, London, 1920—II—701.

Morris, M. F., Jr. Therapy of hyperthyroidism.
Med. Rec., N. Y., 1920—XCVIII—431.

Pearson, J. M. Goiter; its medical treatment.
Cana. M. Ass. J., Toronto, 1920—X—983.

Porter, M. F. Goiter.
Ann. Surg., Phila., 1920—LXXII—129.

Porter, M. F. Hyperactivity of thyroid.
J. Indiana M. Ass., Ft. Wayne, 1920—XIII—295.

Poppens, Peter H. Tetany following thyroidectomy.
J. Am. M. Ass., Chicago, 1920—LXXV—1068.

Rachford, B. K. Substernal goiter, with pressure symptoms.
Am. J. M. Sc., Phila., 1920—CLX—410.

Ribbert. Necropsy of sarcoma of thyroid.
Arch. f. klin. Chir., Berl., 1920—CXIII—248.

Rogers, J. Organ therapy in thyroid and allied disorders.
Med. Rec., N. Y., 1920—XCVIII—631.

Rowe, A. H. Basal metabolism in thyroid disease aid to diagnosis and treatment; utility of modified Tissot apparatus.
Calif. State J. M., San Fran., 1920—XVIII—332.

Russell, W. B. Toxic goiter in Orientals.
National M. J., China, Shanghai, 1920—VI—101.

Schiassi, B. Outcome with exophthalmic goiter.
Policlin., Roma, 1920—XXVII—285.

Sergent, E. Exophthalmic goiter mistaken for tuberculosis.
Paris méd., 1920—X—80.

Sloan, E. P. Tubercular goiter patient.
Illinois M. J., Oak Park, 1920—XXXVIII—144.

Starr, F. N. G., Graham, R. R., and Robinson, W. L. Goiter.
Cana. Ass. J., Toronto, 1920—X—977.

Stiell, W. F. Subthyroidism.
Practitioner, Lond., 1920—CV—146.

Terry, W. I. Toxic goiter.
Ann. Surg., Phila., 1920—LXXII—152.

Tourneux, J. P. Acute suppurative thyroiditis.
Progres méd., Par., 1920—XXXV—371.

Van Meter, B. F. Goiter.
Kentucky M. J., Louisville, 1920—XVIII—297.

SECTION 26.—PITUITARY.

Behse, E. Pituitary tumor.
Finska läk-sällsk. handl., Helsingfors, 1920—LXII—382.

Coulaud, E. Thyroid and pituitary organotherapy.
Bull. méd., Par., 1920—XXXIV—859.

Engelbach, Wm. Classification of disorders of hypophysis.
Endocrinology, Los Angeles, 1920—IV—347.

Larson, J. A. Further evidence on functional correlation of hypophysis and thyroid.
American J. Physiol., Baltimore, 1920—LIII—89.

Lissner, H. H. Hypopituitarism; report of case.
Endocrinology, Los Angeles, 1920—IV—403.

Mieres, J. F. Exophthalmic goiter in the tuberculous.
Semana med., Buenos Aires, 1920—XXVII—507.

Redwood, F. H. Some disturbances of pituitary gland.
Virginia M. Month., Richmond, 1920—XLVII—301.

Seaman, E. C. Presence of iodin in large quantities of sheep pituitary gland.
J. Biol. Chem., Baltimore, 1920—XLIII—1.

SECTION 27.—ENDOCRANIAL AFFECTIONS AND LUMBAR PUNCTURE.

Barnhill, J. F. Anomalous sigmoid sinus thrombosis; report of cases.
Med. Rec., N. Y.. 1920—XCVIII—388.

Edmunds, T. W., and Dudley, G. B., Jr. Case of mastoiditis, with necrosis of bony lamina covering sigmoid portion of lateral sinus.
Virginia M. Month., Richmond, 1920—XLVII—317.

Geymüller, E. Actinomycosis of neck and brain.
Deutsche Ztschr. f. Chir., Leipz., 1920—CLI—200.

Glogau, O. Mastoidectomy (perisinus abscess, exposure of dura) followed by attacks of toxic insanity; recovery.
Laryngoscope, St. Louis, 1920—XXX—566.

Grahe, K. The internal ear in lethargic encephalitis.
Münchener med. Wchnschr., Munich, 1920—LXVII—629.

Hassin, G. B., Levy, D. M., and Tupper, W. E. Facial pontine diplegia (traumatic).
J. Nerv. & Men. Dis., N. Y., 1920—LII—25.

Head, H. Aphasia and kindred disorders of speech.
Brain, London, 1920—XLIII—87.

Hill, Frederick T. Lateral sinus thrombosis, with report of seven cases.
Ann. Otol., Rhinol. and Laryngol., St. Louis, 1920—XXIX—829.

Leegard, F. Otogenous pyemia, sinus phlebitis and sinus thrombosis.
Norsk Mag. f. Laegevidensk., Kristiania, 1920—XXCI—745.

Lobell, Abraham. A case of cerebellar abscess diagnosed post-mortem.
J. Am. M. Ass., Chicago, 1920—LXXV—600.

Lyons, Horace Raymond. Barany tests in supratentorial tumors proved by operation or necropsy.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—898.

Milesi, G. Auditory neuritis in meningitis.
Policlin., Roma, 1920—XXVII—924.

Rivers, T. M. Indol test on the spinal fluid for rapid diagnosis of influenzal meningitis.
J. Am. M. Ass., Chicago, 1920—LXXV—1495.

Robinson, J. A. Cavernous sinus thrombosis following a secondary mastoidectomy.
Laryngoscope, St. Louis, 1920—XXX—574.

Rott, Otto M. Concerning the question of jugular ligation in sinus thrombosis.
Ann. Otol., Rhinol. & Laryngol., St. Louis, 1920—XXIX—820.

Speidel. Late results of encephalitis after influenza.
Münchener med. Wchnschr., Munich, 1920—LXVII—630.

Vail, H. H. Studies by Barany rotation and caloric tests of tumors of nervus acusticus.
Laryngoscope, St. Louis, 1920—XXX—505.

SECTION 28.—CRANIAL NERVES.

Bercher, J. Indications and technic for blocking inferior dental nerve.
Paris méd., 1920—X—133.

Cecilia, J. Santa. Eye sign of facial paralysis.
Bravil med., Rio de Jan., 1920—XXXIV—444.

Cushing, H. Experiences with 332 Gasserian operations.
Am. J. M. Sc., Phila., 1920—CLX—157.

Dittman, G. C. Paralysis of abducens nerve secondary to mastoiditis.
Minnesota Med., St. Paul, 1920—III—439.

Ellett, E. C. Optic neuritis, associated with disease of the nasal sinuses; report of two cases.
J. Am. M. Ass., Chicago, 1920—LXXV—805.

Garland, J., and White, P. D. Paralysis of left recurrent laryngeal nerve associated with mitral stenosis.
Arch. Int. Med., Chicago, 1920—XXVI—343.

Hassin, G. B., Levy, D. M., and Tupper, W. E. Facial pontine diplegia (traumatic).
J. Nerv. & Men. Dis., N. Y., 1920—LII—25.

Heitger, Joseph D. The present status of neurootology from the borderline standpoint.
J. Am. M. Ass., Chicago, 1920—LXXV—800.

Marriott, W. McKim. Postdiphtheritic paralysis of the respiratory muscles: Report of case treated by prolonged artificial respiration.
J. Am. M. Ass., Chicago, 1920—LXXV—668.

McKenzie, D. Aqueduct of fallopius and facial paralysis.
J. Laryngol., Lond., 1920—XXXV—244, 271, 296.

Rich, A. B. Innervation of tensor veli palatini and levator veli palatini muscles.
Johns Hopkins Hosp. Bull., Balt., 1920—XXXI—305.

Romanos, Mesonero. Herpes zoster of ear and neck, with peripheral facial paralysis.
Siglo med., Madrid, 1920—LXVII—401.

Vail, H. H. Studies by Barany rotation and caloric tests of tumors of nervus acusticus.
Laryngoscope, St. Louis, 1920—XXX—505.

SECTION 29.—PLASTIC SURGERY.

Brown, G. V. I. Plastic work in surgery of the jaw.
Wisconsin M. J., Milwaukee, 1920—XX—143.

Chubb, G. New method in rhinoplasty.
Lancet, London, 1920—II—354.

Cohen, L. Correct rhinoplasty.
Surg., Gynec. & Obst., Chicago, 1920—XXXI—412.

Dorrance, Geo. M. Epithelial inlays versus skin or mucous membrane flaps for replacing lost mucous membrane in the mouth.
J. Am. M. Ass., Chicago, 1920—LXXV—1179.

Oppenheimer, S. Condemnatory note on use of paraffin in cosmetic rhinoplasty.
Laryngoscope, St. Louis, 1920—XXX—595.

Oppenheimer, S. Implantation methods in cosmetic rhinoplasty.
Boston M. & S. J., 1920—CLXXXIII—329.

SECTION 30.—INSTRUMENTS.

Imperatori, C. J. Apparatus for irrigating nasal cavities, useful in home treatment.
Laryngoscope, St. Louis, 1920—XXX—550.

Shapiro, A. F. Instrument for simplifying tonsillectomy by snare.
N. York M. J., 1920—CXII—681.

Unger, M. New instrument and method for washing and draining nasal sinuses.
Laryngoscope, St. Louis, 1920—XXX—561.

SECTION 31.—RADIOLOGY.

Aikins W. H. B. Radium in toxic goiter.
Am. J. Roentgenol., N. Y., 1920—VII—404.

Bingham, G. H., and Richards, G. E. Corelation of results of treatment of goiter by surgical and roentgen ray methods.
Canad. M. Ass. J., Toronto 1920—X—988.

Bowen, C. F. Fractures of bones of face.
Am. J. Roentgenol., N. York, 1920—VII—350.

Leulero. Radiography of lower jaw.
J. de radiol. et d'electrol., Paris, 1920—IV—36.

Mitchell, W. Case of broncho-esophageal fistula.
Arch. Radiol. & Electroth., Lond., 1920—49.

Sonnenschein, Robert. Radium in the treatment of malignant tumors of the nose and throat: its use and possible abuse.
J. Am. M. Ass., Chicago, 1920—LXXV—860.

Von Dworzak, Z. Radium therapy in diseases of nose, ear and throat.
Colorado Med., Denver, 1920—XVII—238.

SECTION 34.—EYE.

Beck, J. C., and Deutsch, E. Interrelation between eye, ear, nose and throat with presentation of cases.
Am. J. Ophthalmol., Chicago, 1920—III—349.

Berens, C., and Uren, C. T. Effect of nose and throat infections on ocular functions of aviators.
Am. J. Ophthalmol., Chicago, 1920—III—170.

Cecilia, J. Santa. Eye sign of facial paralysis.
Bravil med., Rio de Jan., 1920—XXXIV—444.

Crile, G. W. Special consideration of toxic adenoma in relation to exophthalmic goiter.
Ann. Surg., Phila., 1920—LXXII—141.

Crotti, A. Etiology and pathology of exophthalmic goiter: their bearing on prevention, prognosis and treatment.
Ohio M. J., Columbus, 1920—XVI—738.

Ellett, E. C. Optic neuritis, associated with disease of the nasal sinuses; report of two cases.
J. Am. M. Ass., Chicago, 1920—LXXV—805.

Forbes, H. H. Use of radium in esophageal cancer.
N. York M. J., 1920—CXII—568.

Judd, E. S. Results of operation for adenoma with hyperthyroidism and exophthalmic goiter.
Ann. Surg., Phila., 1920—LXXII—145.

Judd, E. S. Results of surgical treatment of exophthalmic goiter.
N. York State J. M., 1920—XX—287.

Liebault, G. Acute frontal sinusitis and ptosis.
Bull. méd., Par., 1920—XXXIV—815.

Loeb, H. W. Two cases of blindness relieved by ethmoid exenteration; case of keratoiritis due to tonsil infection.
J. Missouri M. Ass., St. Louis, 1920—XVII—409.

Meller. Relation of retrobulbar neuritis to nasal cavity.
Wien. klin. Wchnschr., 1920—XXXIII—205.

Marine, D. Physiology of normal thyroid and physiology of thyroid in exophthalmic goiter.
Ohio M. J., Columbus, 1920—XVI—735.

Moore, R. F. Exophthalmos and limitation of eye movements of exophthalmic goiter.
Lancet, London, 1920—II—701.

Nagel, C. S. G. Congenital atresia of lacrimal duct.
Am. J. Ophth., Chicago, 1920—III—406.

Potts, J. B. Nasal infection basis of certain ocular lesions.
Am. J. Ophthalmol., Chicago, 1920—III—195.

Schiassi, B. Outcome with exophthalmic goiter.
Policlin., Roma, 1920—XXVII—285.

White, L. E. Diagnosis of accessory sinus disease causing loss of vision.
Laryngoscope, St. Louis, 1920—XXX—551.

Wiener, Meyer and Sauer, W. E. A new operation for the relief of dacryocystitis through the nasal route.
J. Am. M. Ass., Chicago, 1920—LXXV—868.